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(54) **MOBILE SYSTEMS AND METHODS FOR HEALTH, EXERCISE AND COMPETITION**

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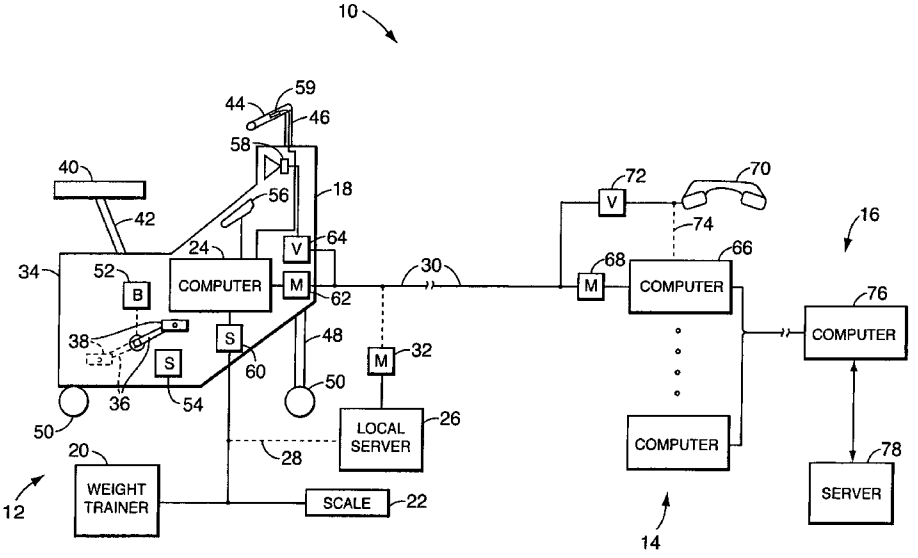
(57) **ABSTRACT**

An exercise system includes a local system having an exercise apparatus and an associated local computer, where the local computer controls and monitors the operation and use, respectively, of the exercise apparatus. The system further includes a remote system having a remote computer, and a transmission medium preferably including the Internet that couples the local system to the remote system for data communication between the local system and the remote system. The remote system may receive local system data from the local system concerning the use of the exercise apparatus, and the local system may receive remote system data from the remote system concerning the operation of the exercise apparatus. The local computer preferably controls the operation of the exercise apparatus based upon a modifiable script stored in a read/write memory of the local computer, which can be updated by the remote system. A method for controlling an exercise apparatus includes running a modifiable script on a local computer to control the use and to monitor the operation of an exercise apparatus, and communicating with a remote system, preferably via the Internet, to provide the remote system with data concerning the use of the exercise apparatus. The script is stored in read/write memory of the local computer and remote system data received from the remote system may include at least a portion of a new script to be stored in the read/write memory of the local computer.

18 Claims, 32 Drawing Sheets



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Restriction Requirement dated Jul. 2, 2007, 5 pages, U.S. Appl. No. 10/674,911.
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Office Action dated Apr. 22, 2008, 10 pages, U.S. Appl. No. 10/674,911.
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Advisory Action dated Jun. 16, 2003, 2 pages, U.S. Appl. No. 09/690,701.
Notice of Allowance and Fee(s) Due, date mailed Nov. 24, 2003, 5 pages, U.S. Appl. No. 09/690,701.
Restriction Requirement dated Dec. 29, 2004, 4 pages, U.S. Appl. No. 10/729,356.
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Restriction Requirement dated Feb. 21, 2006, 5 pages, U.S. Appl. No. 10/729,356.
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Response to Rule 312 Communication, dated Jul. 30, 2007, 2 pages, U.S. Appl. No. 10/729,356.
Office Action dated Jan. 14, 2008, 7 pages, U.S. Appl. No. 10/729,356.
Office Action dated Jan. 24, 2005, 4 pages, U.S. Appl. No. 10/773,617.
Notice of Allowance and Fee(s) Due, date mailed Apr. 17, 2006, 4 pages, U.S. Appl. No. 10/773,617.
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Office Action dated Jan. 27, 2005, 6 pages, U.S. Appl. No. 10/751,334.

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Notice of Allowance and Fee(s) Due dated Sep. 8, 2008, 4 pages, U.S. Appl. No. 11/429,725.
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Notice of Allowance and Fee(s) Due dated Dec. 17, 2008, 5 pages, U.S. Appl. No. 11/440,703.
Final Office Action dated Jan. 6, 2009, 8 pages, U.S. Appl. No. 11/657,701.
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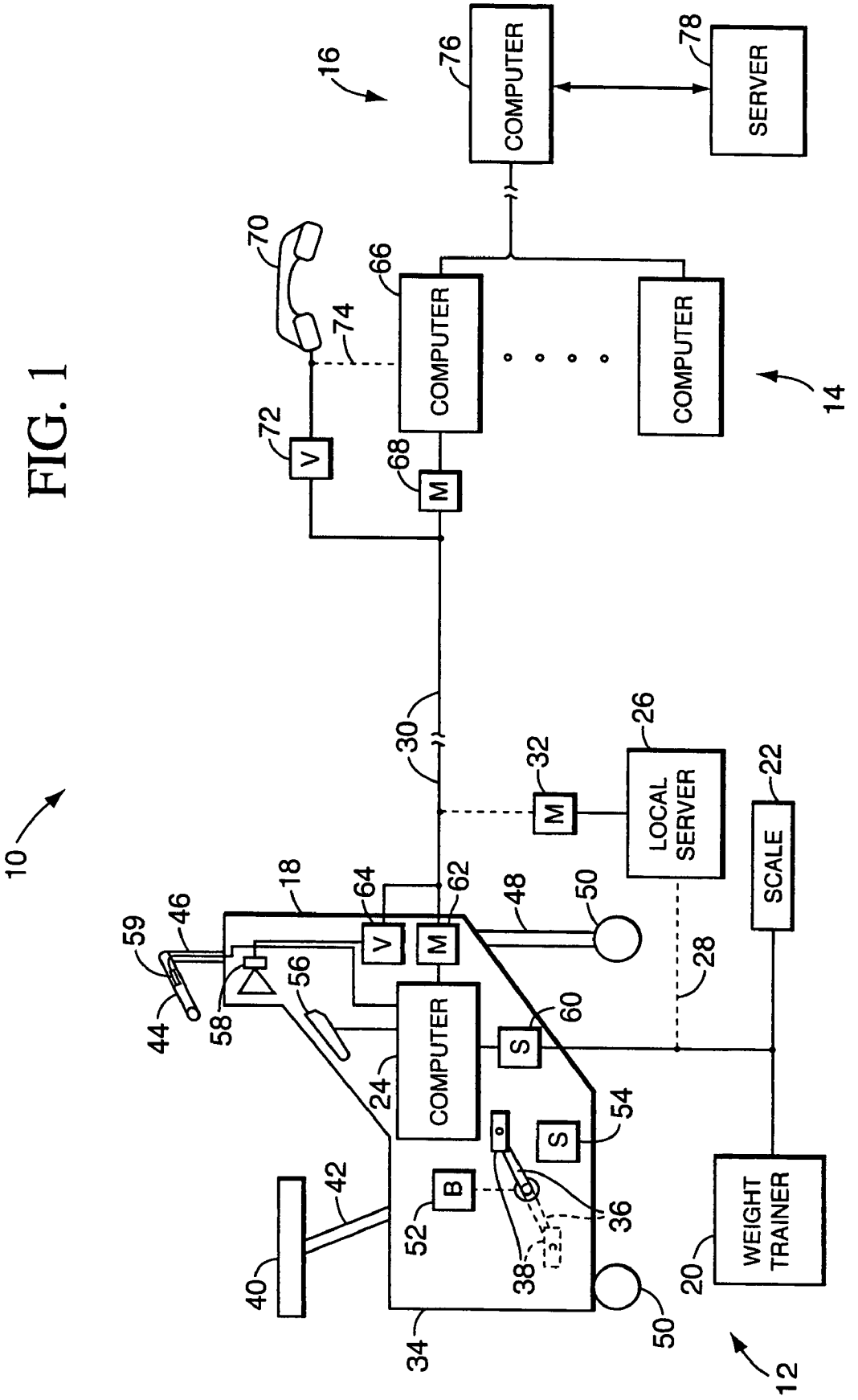
* cited by examiner

FIG. 1


10
12
14
16
18
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22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
59
60
62
64
66
68
70
72
74
76
78
COMPUTER
SERVER
COMPUTER
COMPUTER
LOCAL SERVER
SCALE
WEIGHT TRAINER
V
M
S
B

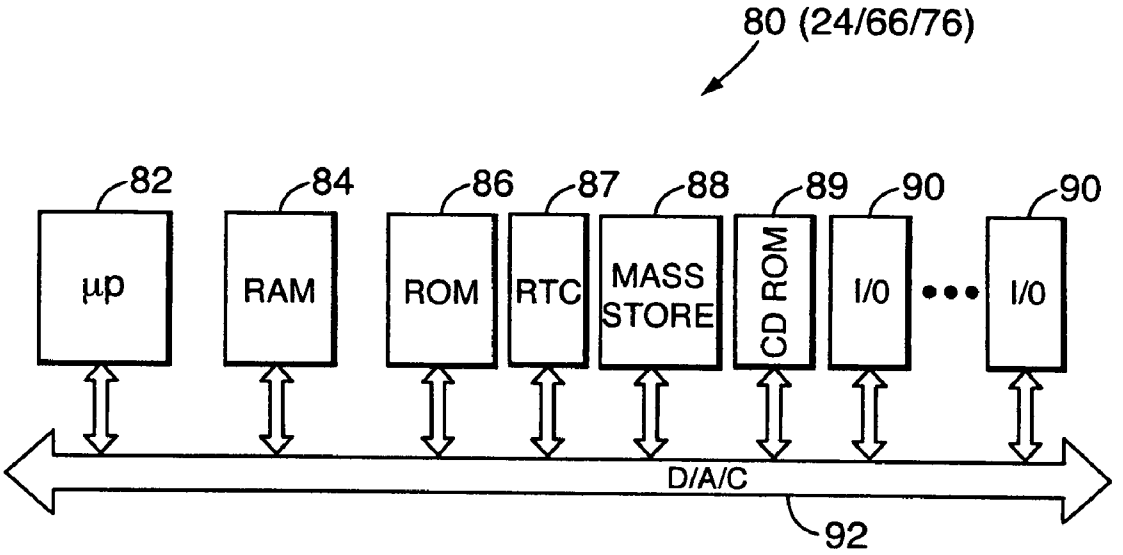

80 (24/66/76)
82
84
86
87
88
89
90
90
µp
RAM
ROM
RTC
MASS STORE
CD ROM
I/O
I/O
D/A/C
92

FIG. 2

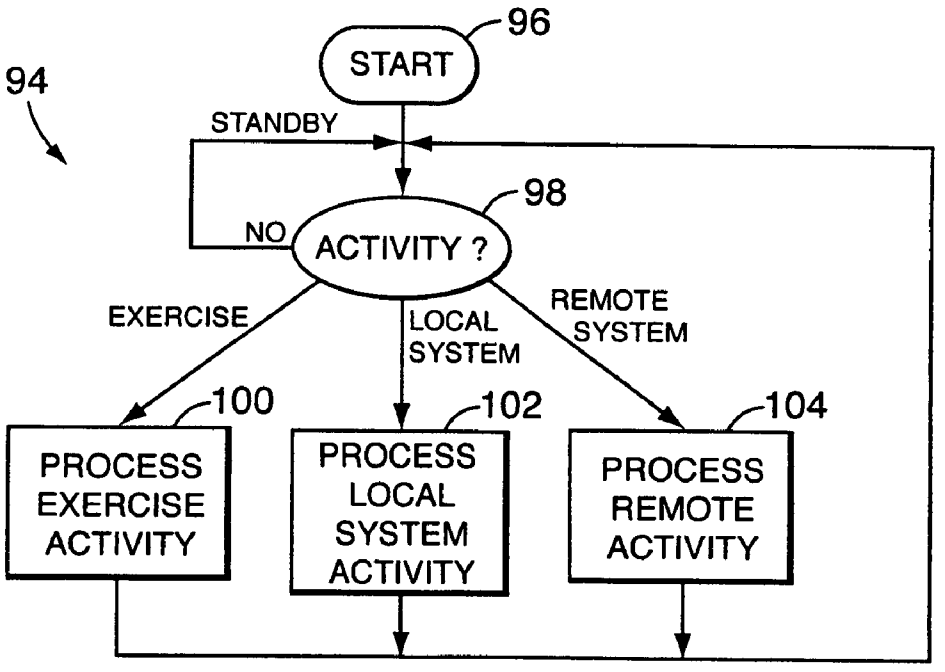

94
96
START
STANDBY
98
NO
ACTIVITY ?
EXERCISE
LOCAL SYSTEM
REMOTE SYSTEM
100
102
104
PROCESS EXERCISE ACTIVITY
PROCESS LOCAL SYSTEM ACTIVITY
PROCESS REMOTE ACTIVITY

FIG. 3

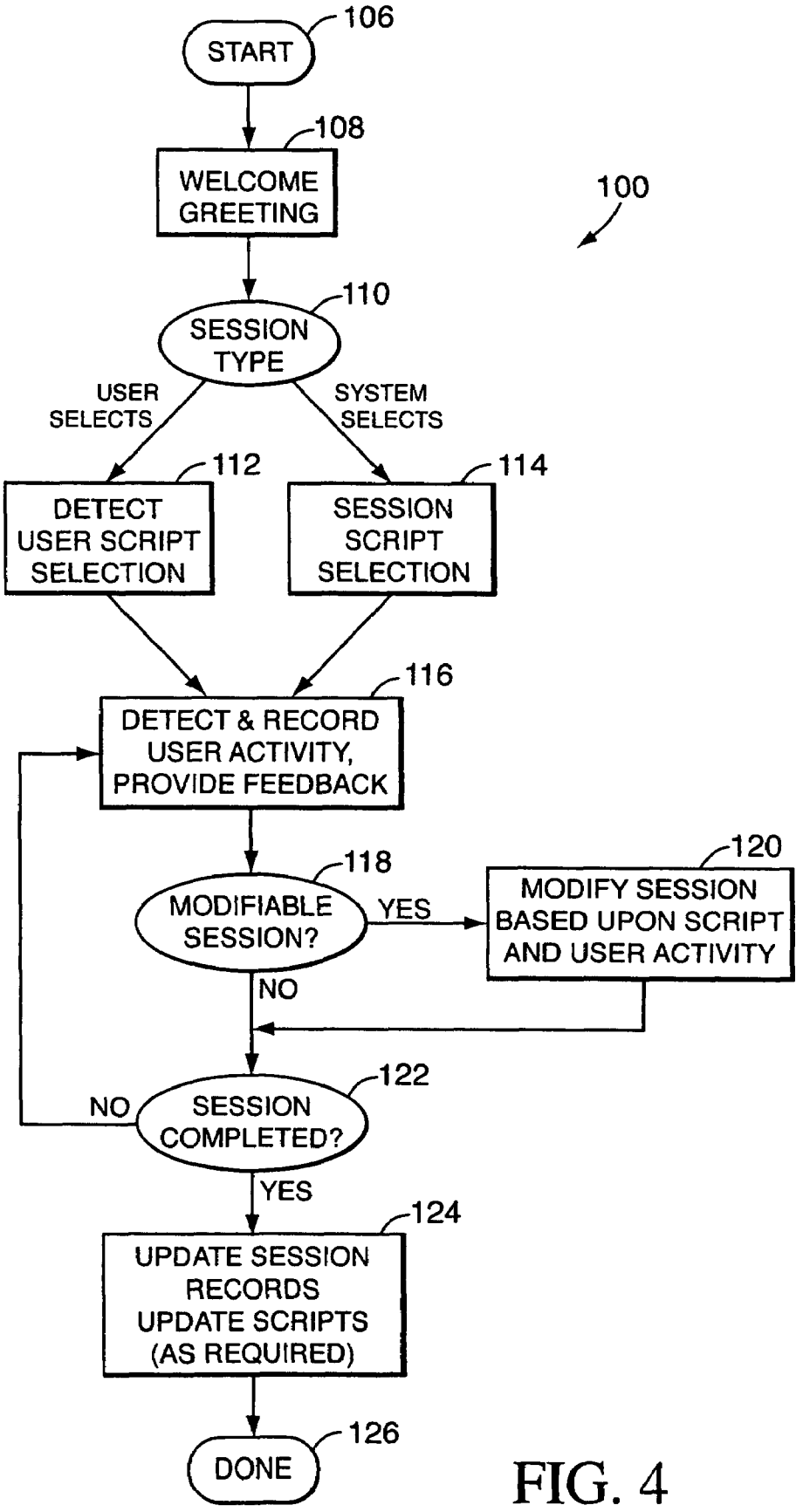

106
START
108
WELCOME GREETING
100
110
SESSION TYPE
USER SELECTS
SYSTEM SELECTS
112
DETECT USER SCRIPT SELECTION
114
SESSION SCRIPT SELECTION
116
DETECT & RECORD USER ACTIVITY, PROVIDE FEEDBACK
118
MODIFIABLE SESSION?
YES
120
MODIFY SESSION BASED UPON SCRIPT AND USER ACTIVITY
NO
122
NO
SESSION COMPLETED?
YES
124
UPDATE SESSION RECORDS UPDATE SCRIPTS (AS REQUIRED)
126
DONE

FIG. 4

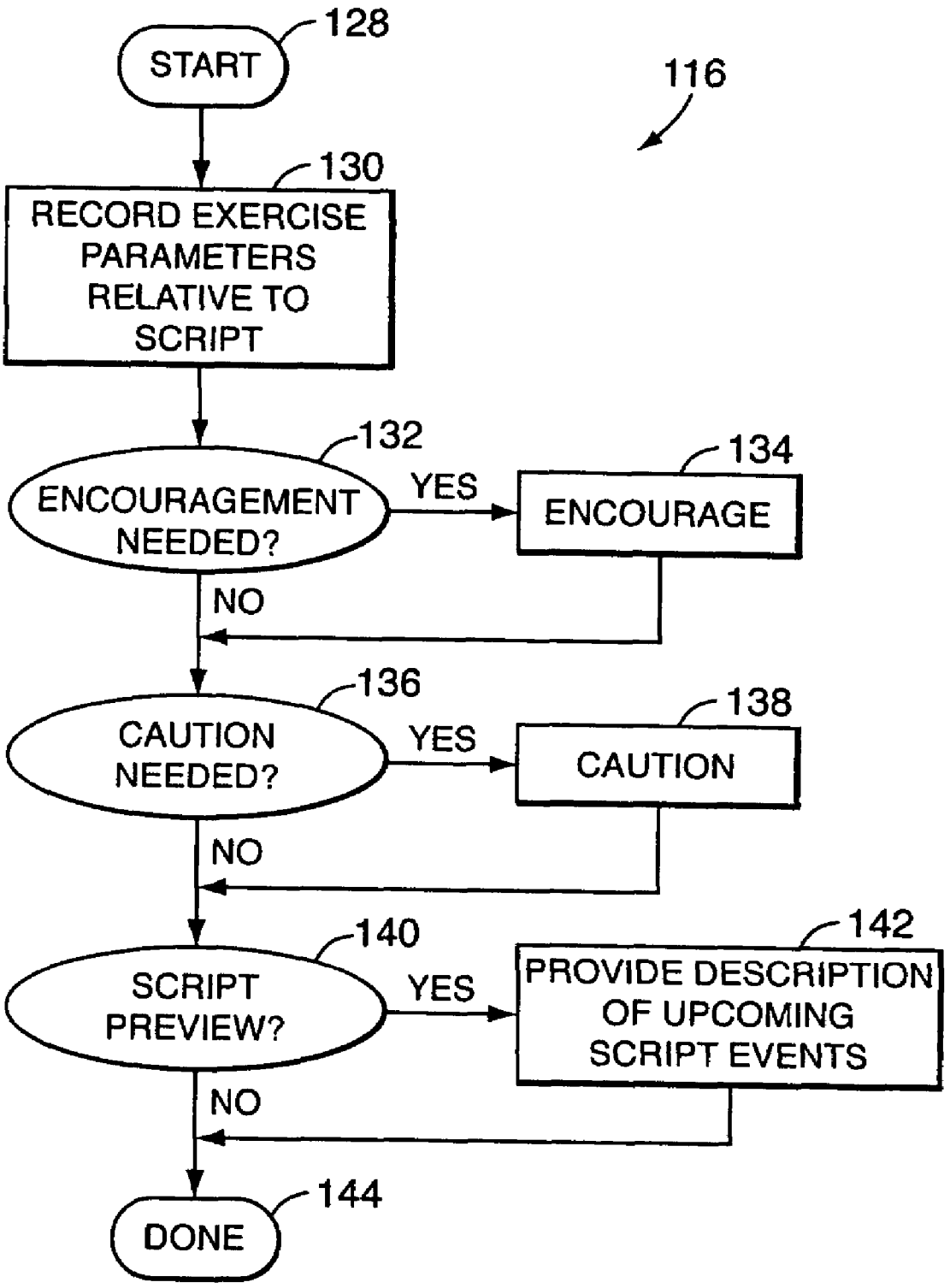
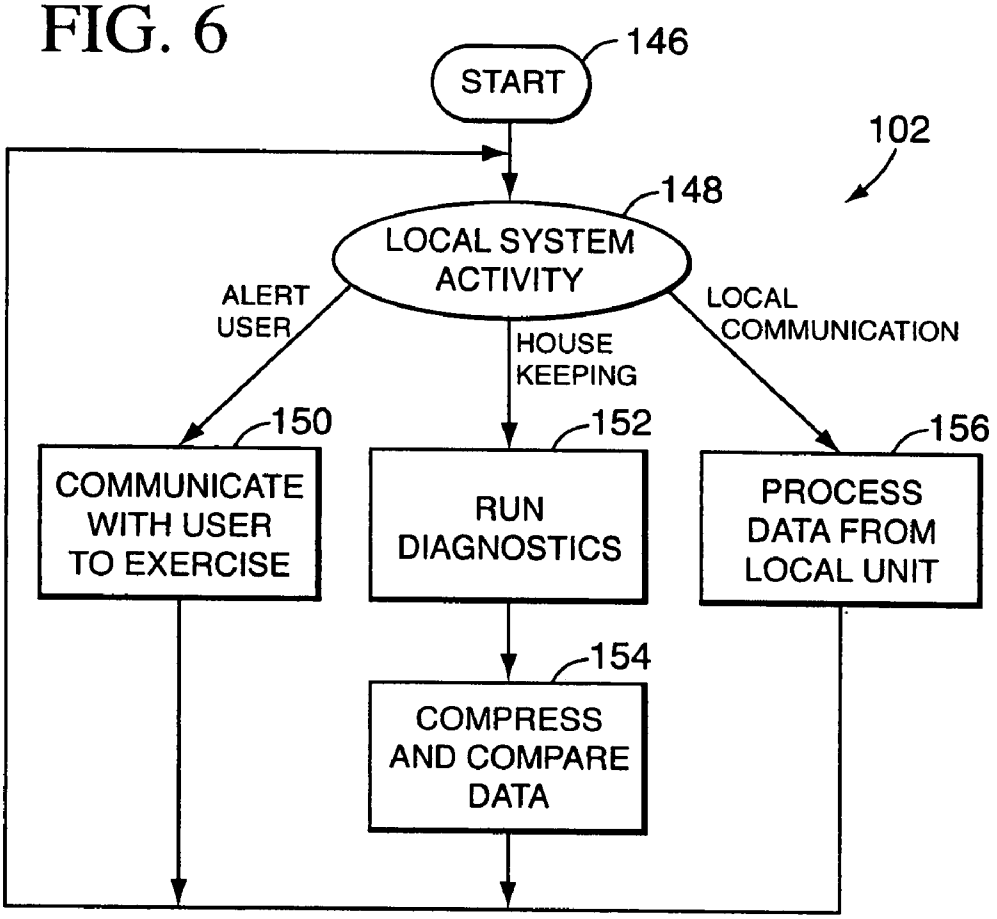

128
START
116
130
RECORD EXERCISE PARAMETERS RELATIVE TO SCRIPT
132
ENCOURAGEMENT NEEDED?
YES
134
ENCOURAGE
NO
136
CAUTION NEEDED?
YES
138
CAUTION
NO
140
SCRIPT PREVIEW?
YES
142
PROVIDE DESCRIPTION OF UPCOMING SCRIPT EVENTS
NO
144
DONE

FIG. 5

FIG. 6


START
146
102
148
LOCAL SYSTEM ACTIVITY
ALERT USER
HOUSE KEEPING
LOCAL COMMUNICATION
150
152
156
COMMUNICATE WITH USER TO EXERCISE
RUN DIAGNOSTICS
PROCESS DATA FROM LOCAL UNIT
154
COMPRESS AND COMPARE DATA

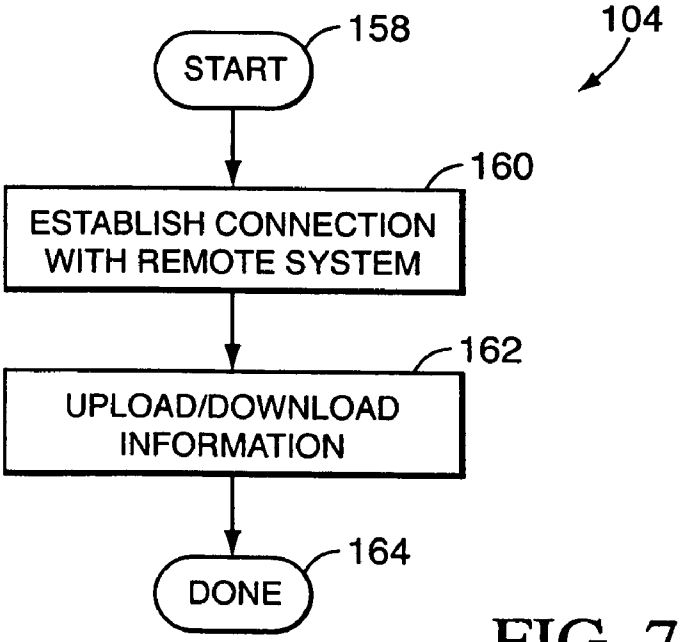

START
158
104
160
ESTABLISH CONNECTION WITH REMOTE SYSTEM
162
UPLOAD/DOWNLOAD INFORMATION
164
DONE

FIG. 7

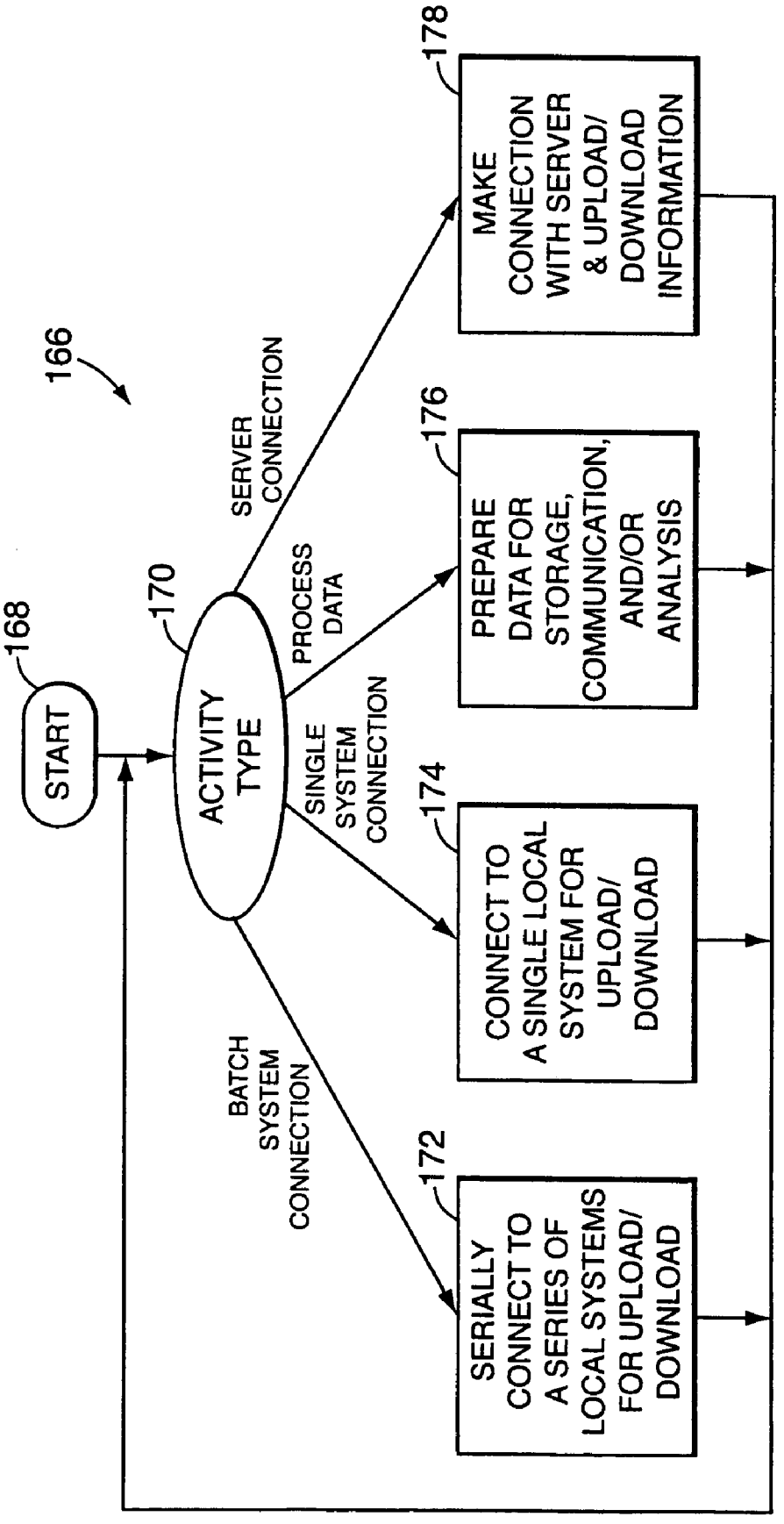

166
168
START
170
ACTIVITY TYPE
SERVER CONNECTION
PROCESS DATA
SINGLE SYSTEM CONNECTION
BATCH SYSTEM CONNECTION
178
MAKE CONNECTION WITH SERVER & UPLOAD/ DOWNLOAD INFORMATION
176
PREPARE DATA FOR STORAGE, COMMUNICATION, AND/OR ANALYSIS
174
CONNECT TO A SINGLE LOCAL SYSTEM FOR UPLOAD/ DOWNLOAD
172
SERIALLY CONNECT TO A SERIES OF LOCAL SYSTEMS FOR UPLOAD/ DOWNLOAD

FIG. 8

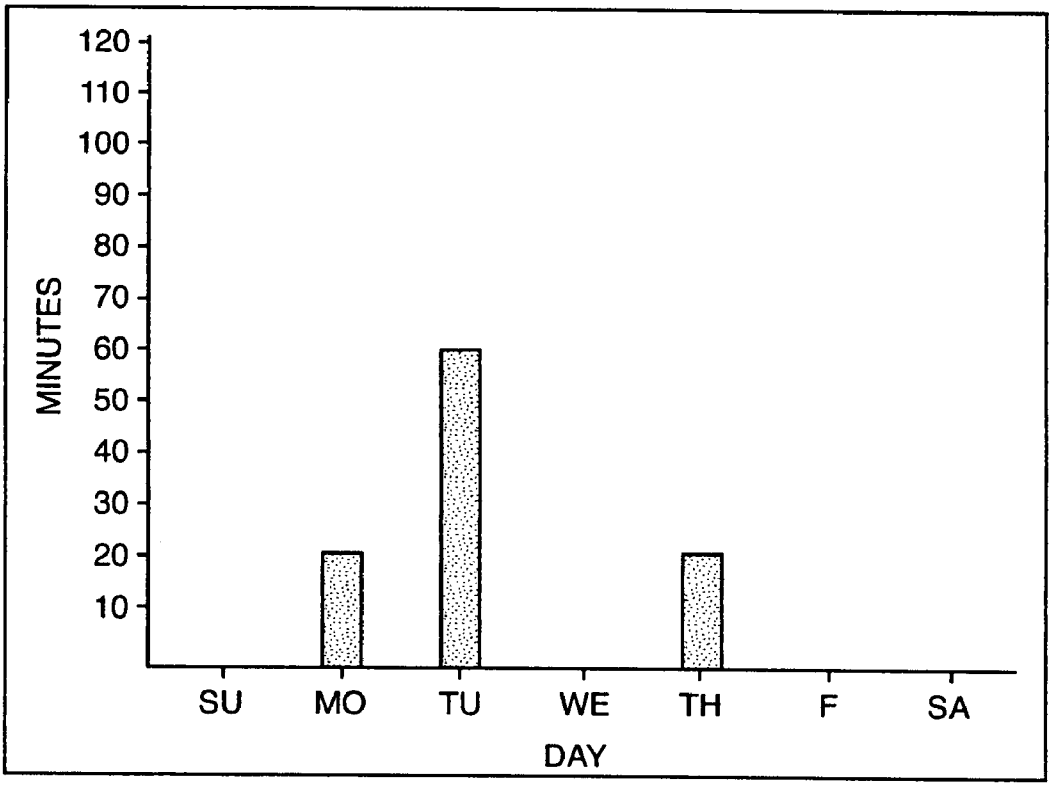


FIG. 8A

SUNDAY
- NO EXEXERCISE

MONDAY
- 10 MINUTES CYCLING
  - 232 CALORIES
  - 6 MINUTES AT 80% HEARTRATE
  - 1.8 MILES
  - DIFFICULTY 6
- 10 MINUTES WEIGHTS
  - 172 CALORIES
  - 20 REPS @ 100 LBS.
  - 20 REPS @ 80 LBS.

TUESDAY
ETC.

FIG. 8B

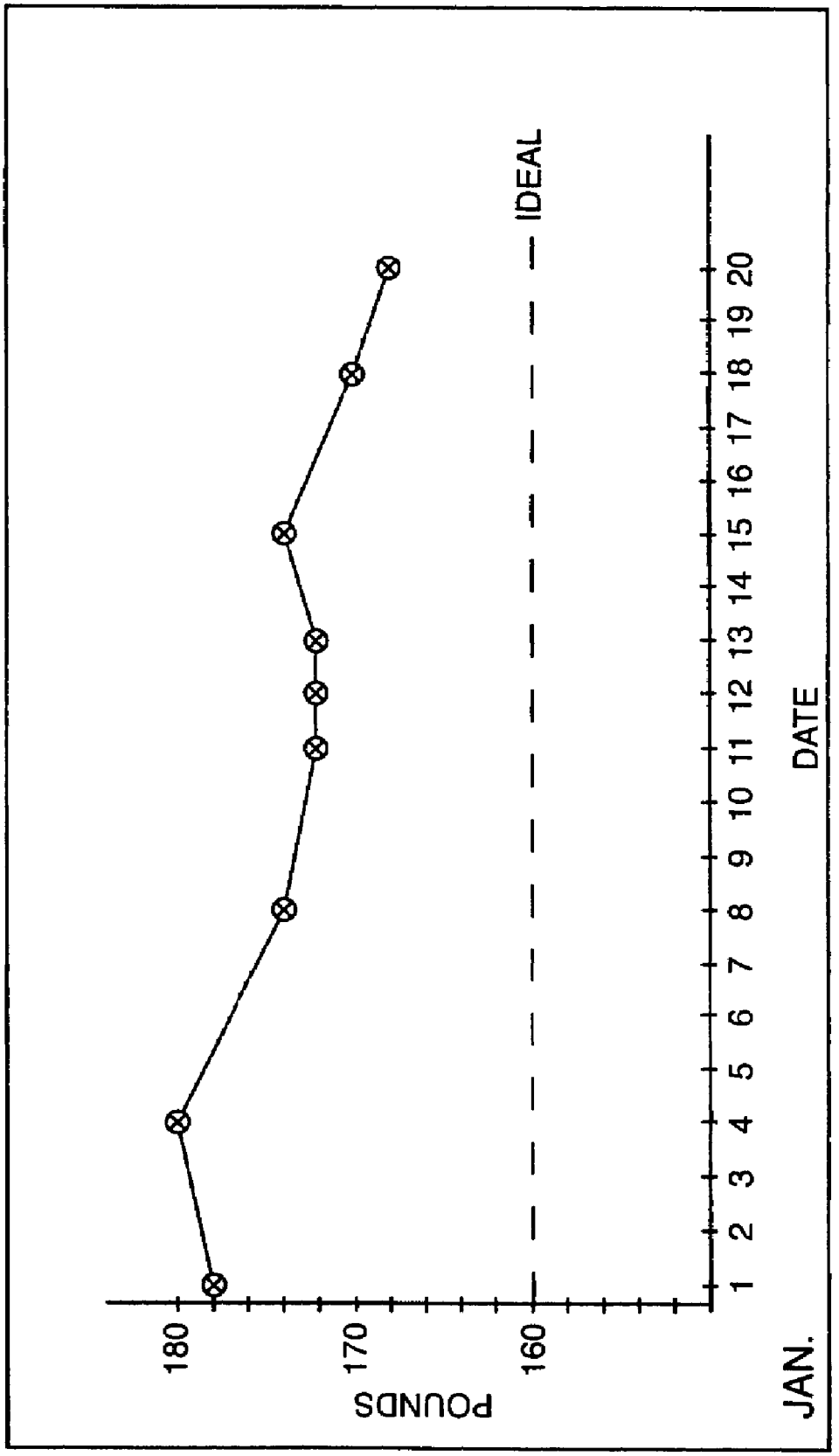

IDEAL
180
170
160
POUNDS
JAN.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DATE

FIG. 8C

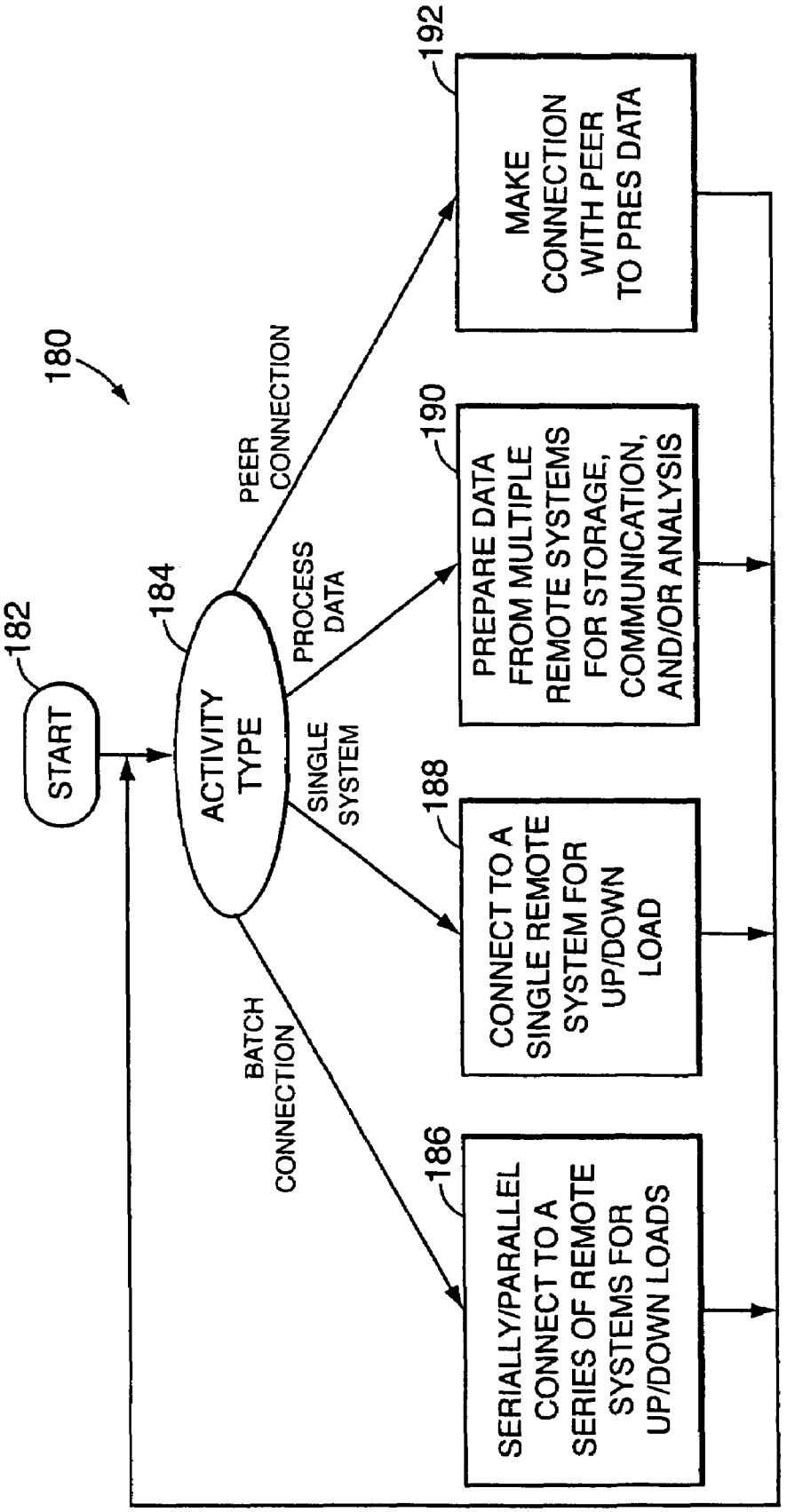

180
182
START
184
ACTIVITY TYPE
PEER CONNECTION
PROCESS DATA
SINGLE SYSTEM
BATCH CONNECTION
192
MAKE CONNECTION WITH PEER TO PRES DATA
190
PREPARE DATA FROM MULTIPLE REMOTE SYSTEMS FOR STORAGE, COMMUNICATION, AND/OR ANALYSIS
188
CONNECT TO A SINGLE REMOTE SYSTEM FOR UP/DOWN LOAD
186
SERIALLY/PARALLEL CONNECT TO A SERIES OF REMOTE SYSTEMS FOR UP/DOWN LOADS

FIG. 9

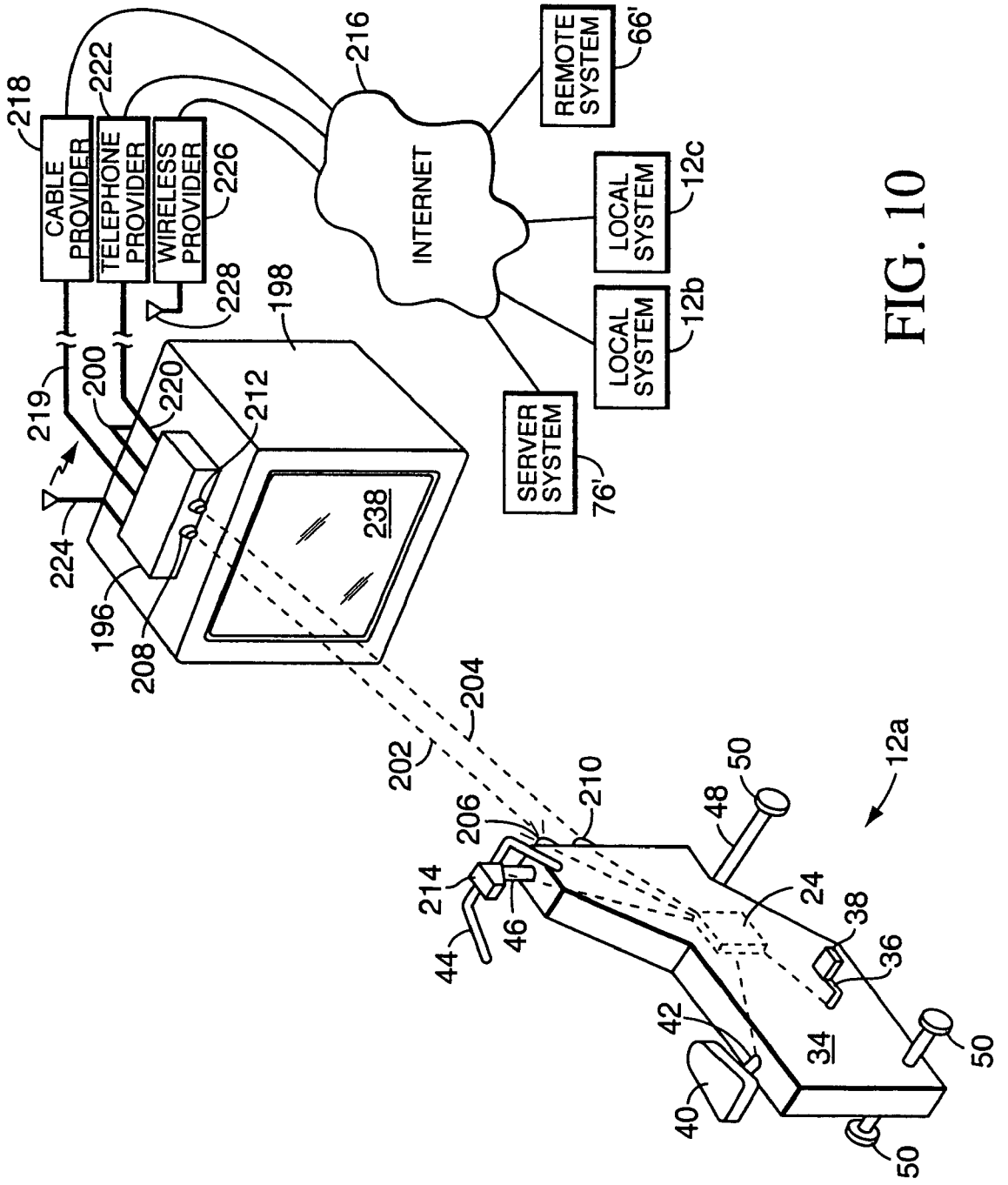

CABLE PROVIDER
TELEPHONE PROVIDER
WIRELESS PROVIDER
INTERNET
REMOTE SYSTEM
LOCAL SYSTEM
LOCAL SYSTEM
SERVER SYSTEM
218
222
226
216
66'
12c
12b
76'
228
198
200
219
220
212
238
224
196
208
204
202
206
210
214
44
46
48
50
24
38
36
42
34
40
12a

FIG. 10

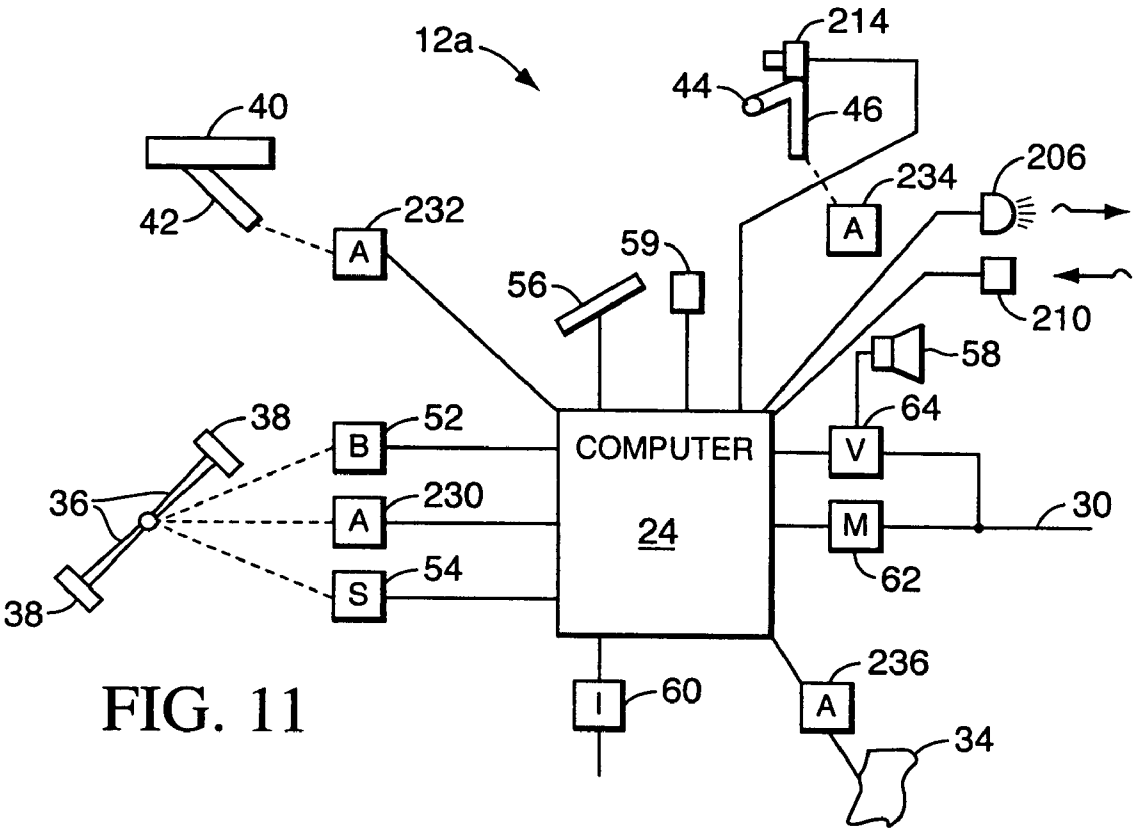
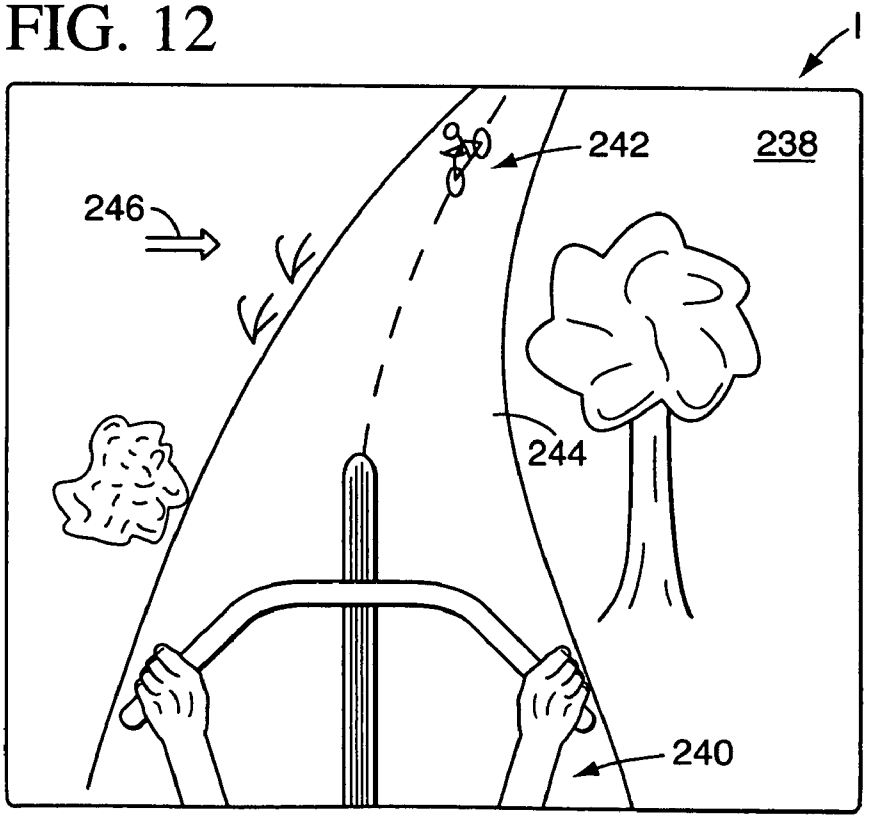

12a
214
44
46
40
42
232
A
234
206
59
56
210
58
38
52
B
COMPUTER
64
V
36
230
A
24
M
30
54
S
62
38
236
I
60
A
34

FIG. 11

FIG. 12


I
242
238
246
244
240

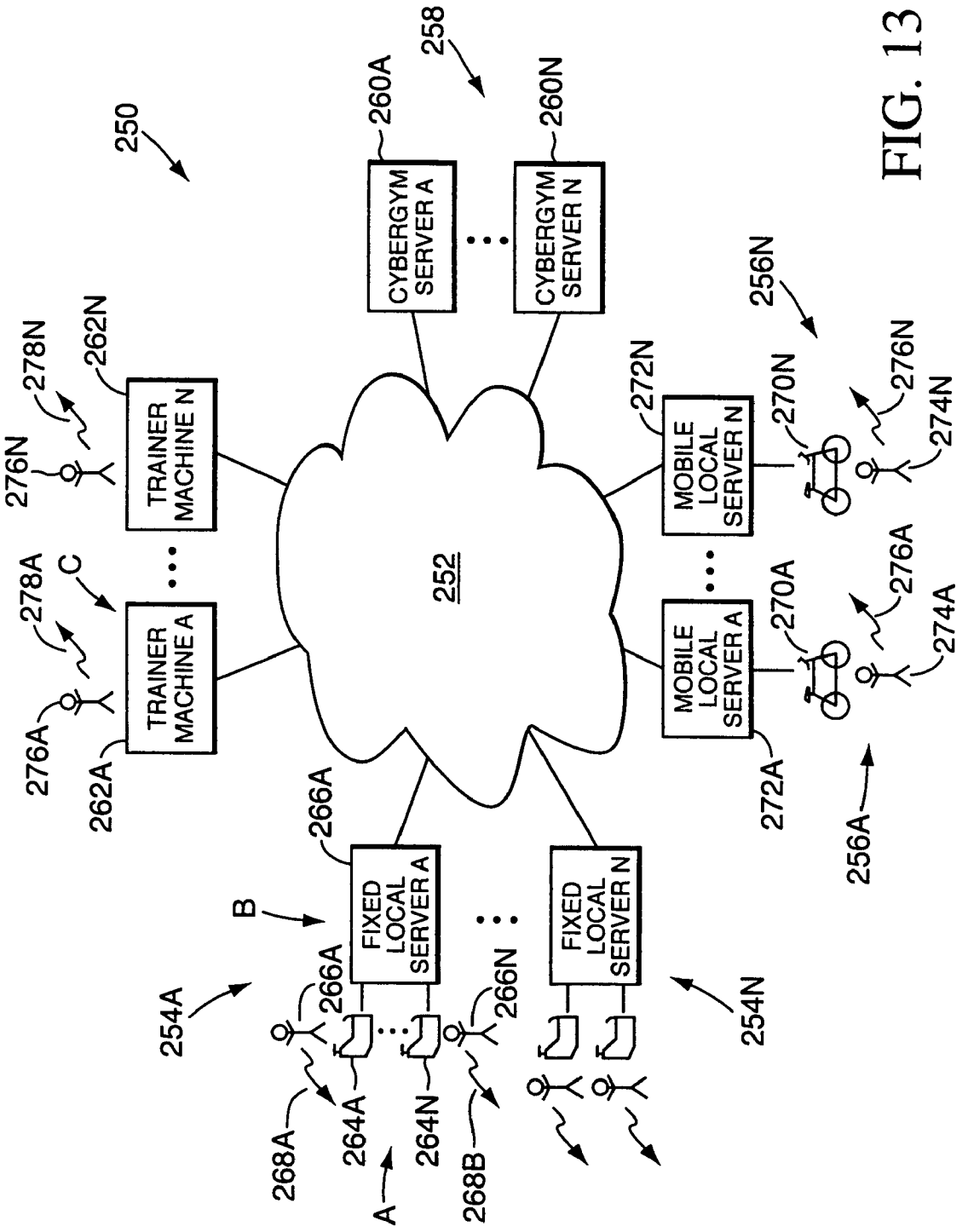

250
252
258
CYBERGYM SERVER A
CYBERGYM SERVER N
260A
260N
TRAINER MACHINE A
TRAINER MACHINE N
262A
262N
MOBILE LOCAL SERVER A
MOBILE LOCAL SERVER N
272A
272N
FIXED LOCAL SERVER A
FIXED LOCAL SERVER N
266A
266N
254A
254N
256A
256N
270A
270N
274A
274N
276A
276N
278A
278N
264A
264N
268A
268B
A
B
C

FIG. 13

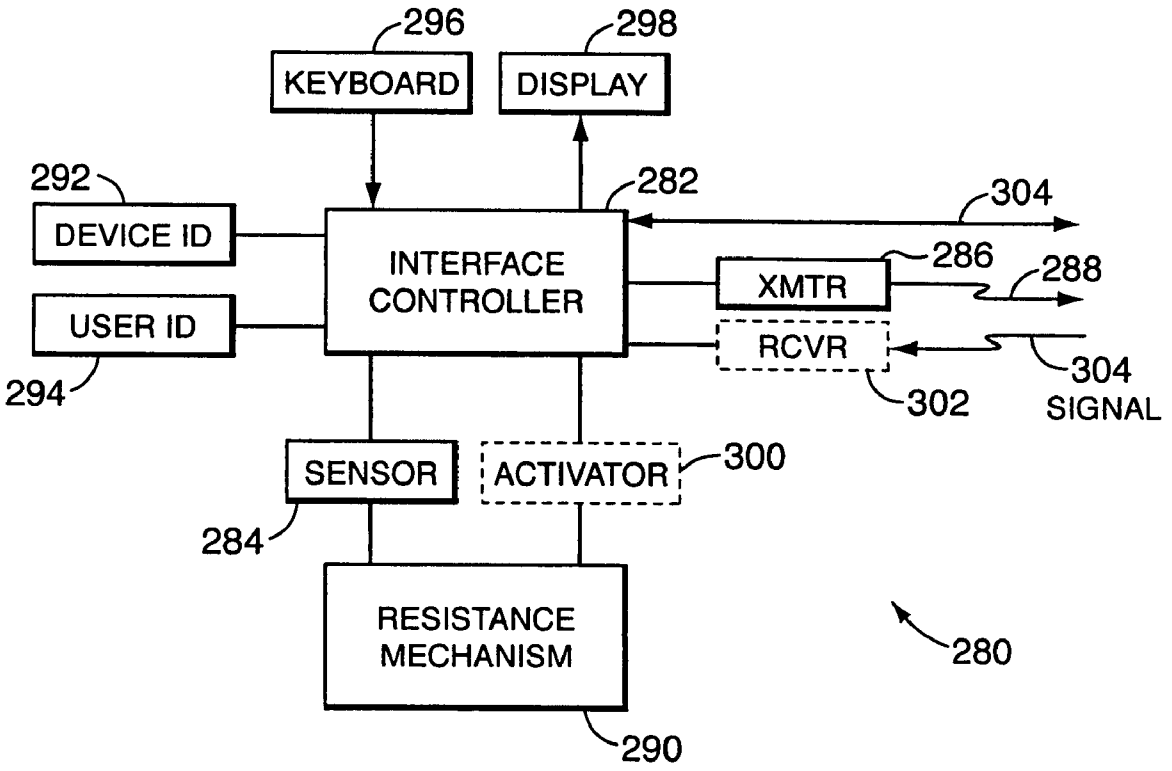

296
298
KEYBOARD
DISPLAY
292
282
304
DEVICE ID
INTERFACE CONTROLLER
286
XMTR
288
USER ID
RCVR
304
SIGNAL
294
302
SENSOR
ACTIVATOR
300
284
RESISTANCE MECHANISM
280
290

FIG. 14

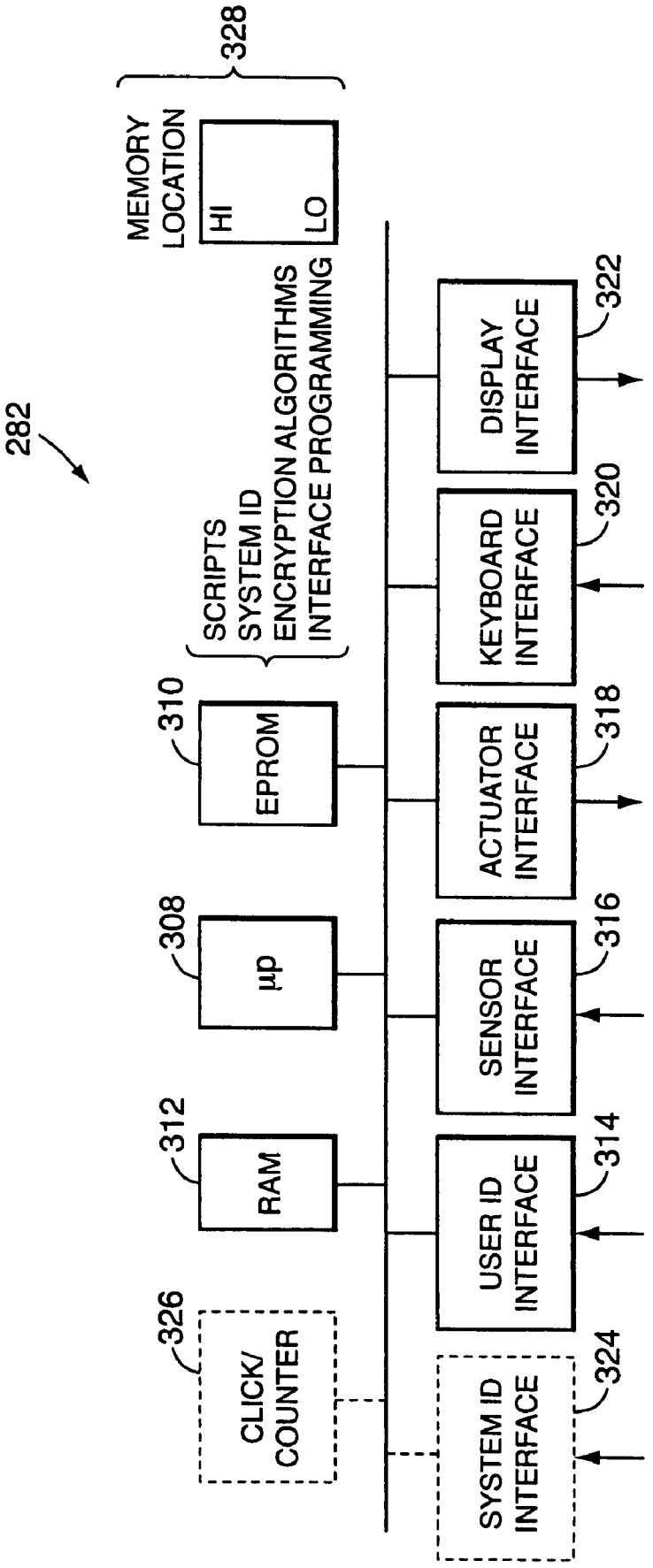

282
328
MEMORY LOCATION
HI
LO
SCRIPTS
SYSTEM ID
ENCRYPTION ALGORITHMS
INTERFACE PROGRAMMING
310
EPROM
308
µp
312
RAM
326
CLICK/ COUNTER
DISPLAY INTERFACE
322
KEYBOARD INTERFACE
320
ACTUATOR INTERFACE
318
SENSOR INTERFACE
316
USER ID INTERFACE
314
SYSTEM ID INTERFACE
324

FIG. 15

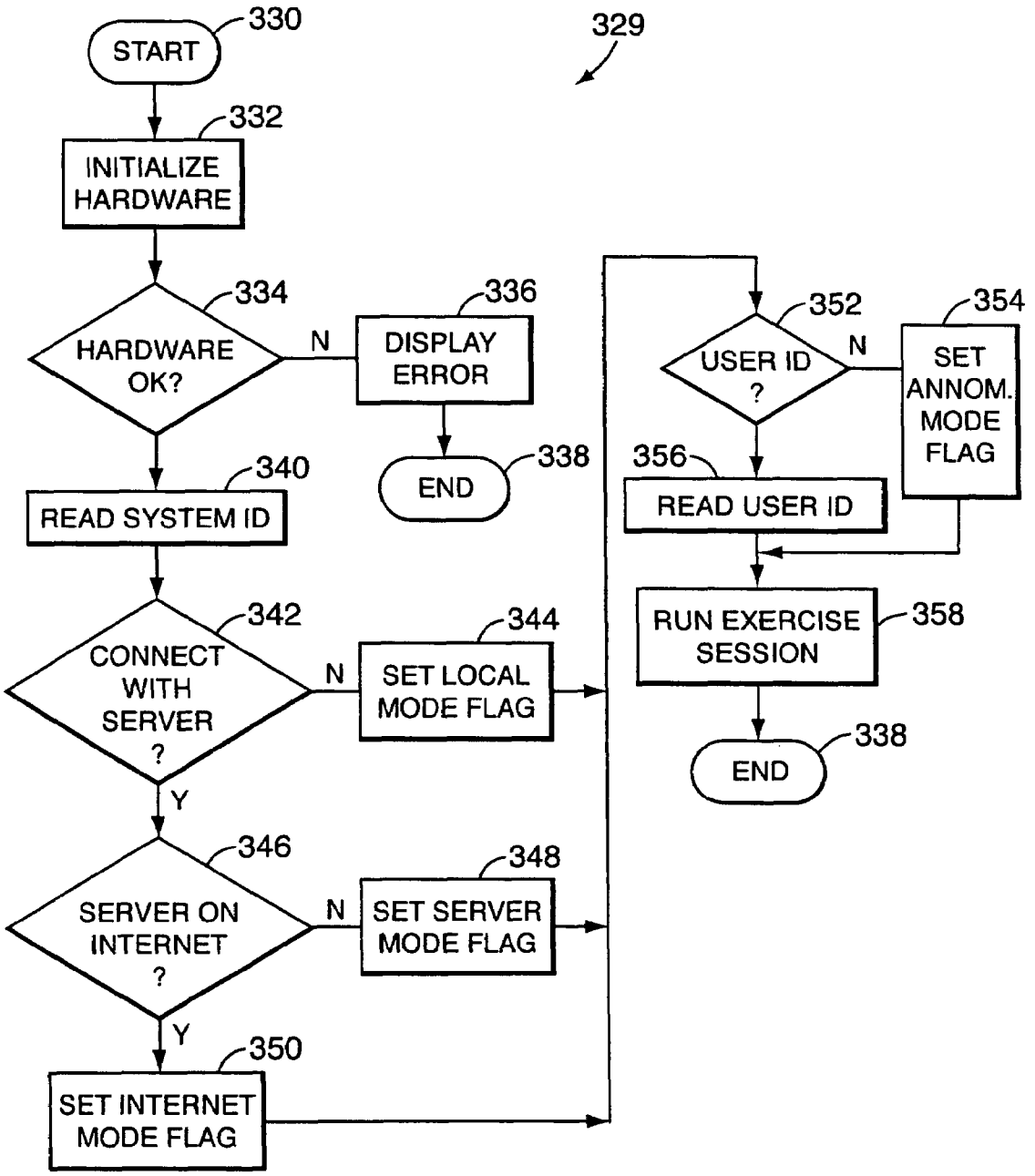

329
START
330
INITIALIZE HARDWARE
332
HARDWARE OK?
334
N
DISPLAY ERROR
336
END
338
READ SYSTEM ID
340
CONNECT WITH SERVER ?
342
N
SET LOCAL MODE FLAG
344
Y
SERVER ON INTERNET ?
346
N
SET SERVER MODE FLAG
348
Y
SET INTERNET MODE FLAG
350
USER ID ?
352
N
SET ANNOM. MODE FLAG
354
READ USER ID
356
RUN EXERCISE SESSION
358
END
338

FIG. 16

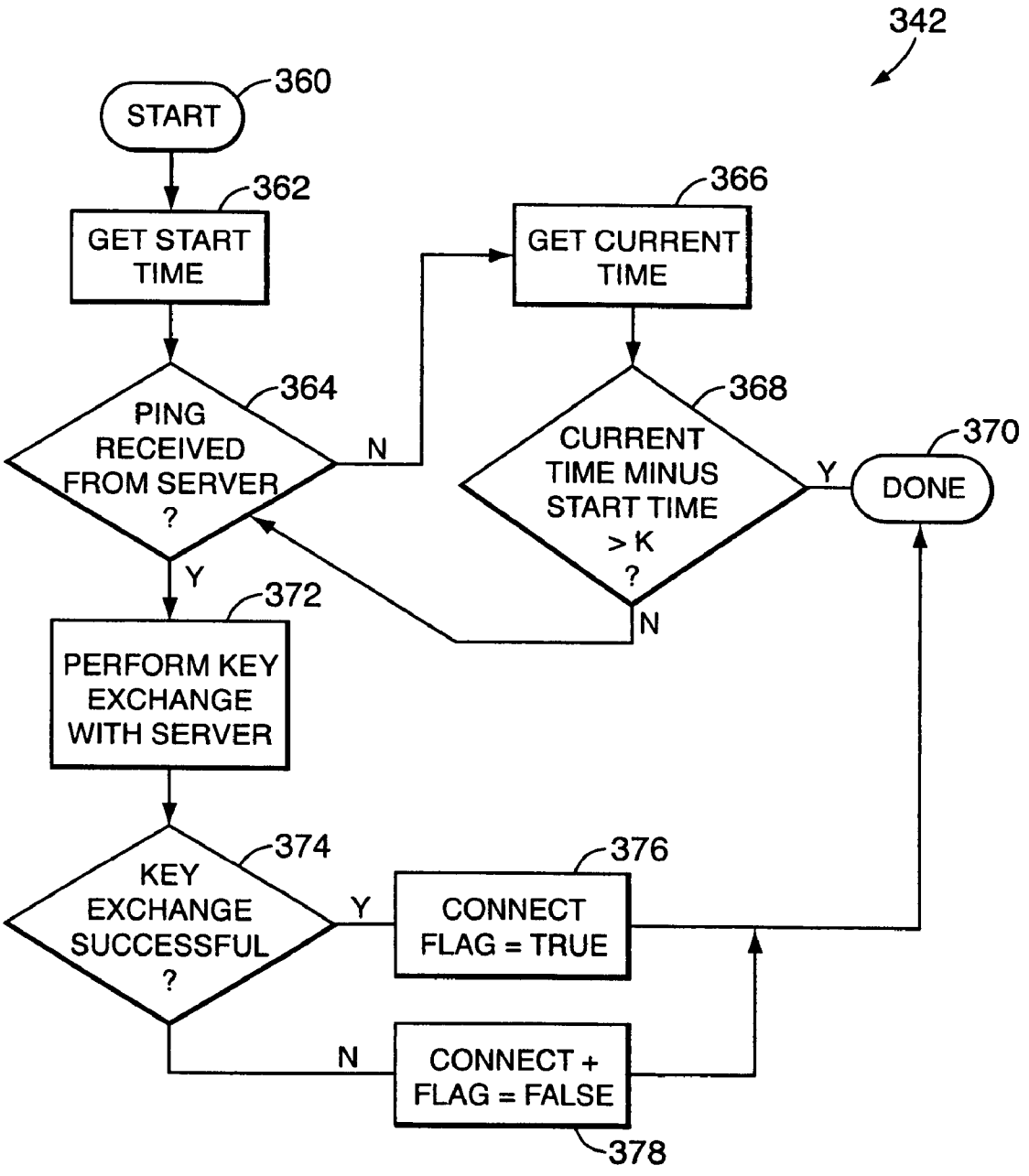

342
START
360
GET START TIME
362
PING RECEIVED FROM SERVER ?
364
N
Y
GET CURRENT TIME
366
CURRENT TIME MINUS START TIME > K ?
368
Y
N
DONE
370
PERFORM KEY EXCHANGE WITH SERVER
372
KEY EXCHANGE SUCCESSFUL ?
374
Y
CONNECT FLAG = TRUE
376
N
CONNECT + FLAG = FALSE
378

FIG. 17

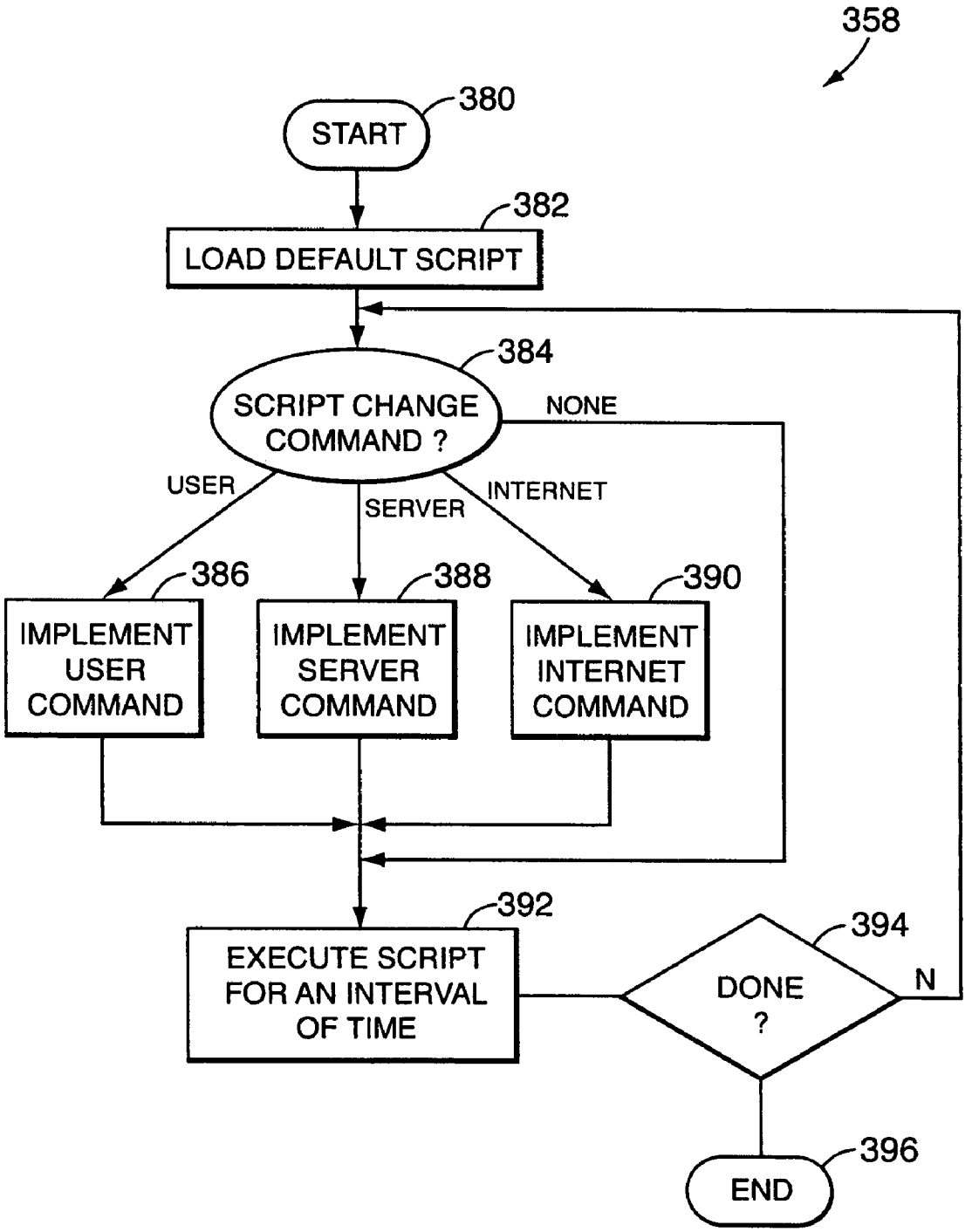

358
380
START
382
LOAD DEFAULT SCRIPT
384
SCRIPT CHANGE COMMAND ?
NONE
USER
SERVER
INTERNET
386
388
390
IMPLEMENT USER COMMAND
IMPLEMENT SERVER COMMAND
IMPLEMENT INTERNET COMMAND
392
EXECUTE SCRIPT FOR AN INTERVAL OF TIME
394
DONE ?
N
396
END

FIG. 18

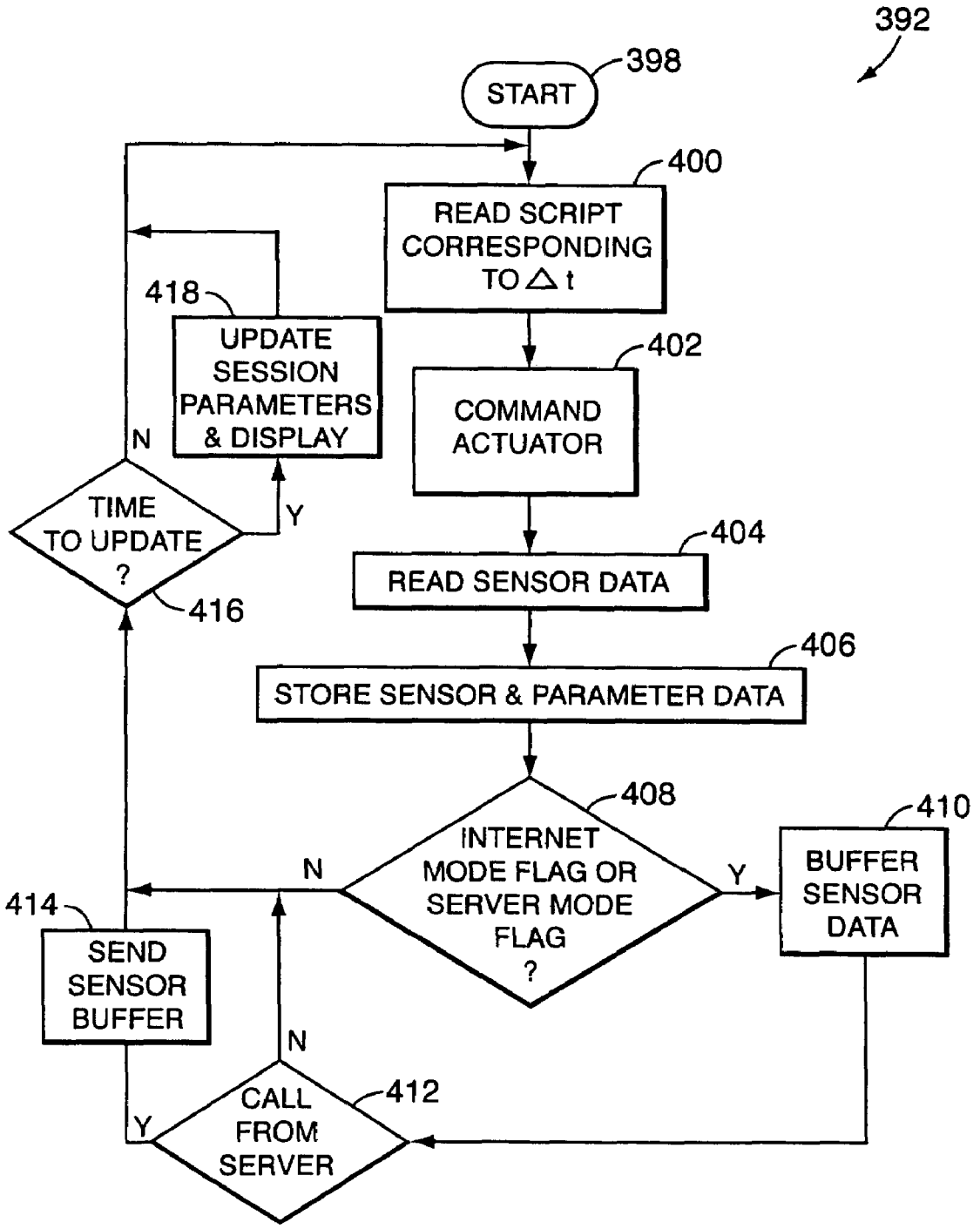
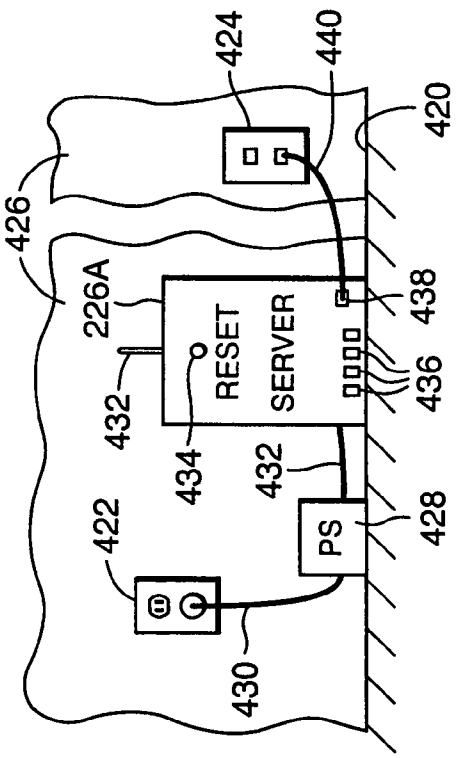

392
START
398
READ SCRIPT CORRESPONDING TO Δt
400
COMMAND ACTUATOR
402
READ SENSOR DATA
404
STORE SENSOR & PARAMETER DATA
406
INTERNET MODE FLAG OR SERVER MODE FLAG ?
408
Y
BUFFER SENSOR DATA
410
N
SEND SENSOR BUFFER
414
CALL FROM SERVER
412
Y
N
TIME TO UPDATE ?
416
Y
N
UPDATE SESSION PARAMETERS & DISPLAY
418

FIG. 19

FIG. 20


424
440
420
426
226A
438
RESET
SERVER
432
436
434
432
422
PS
428
430

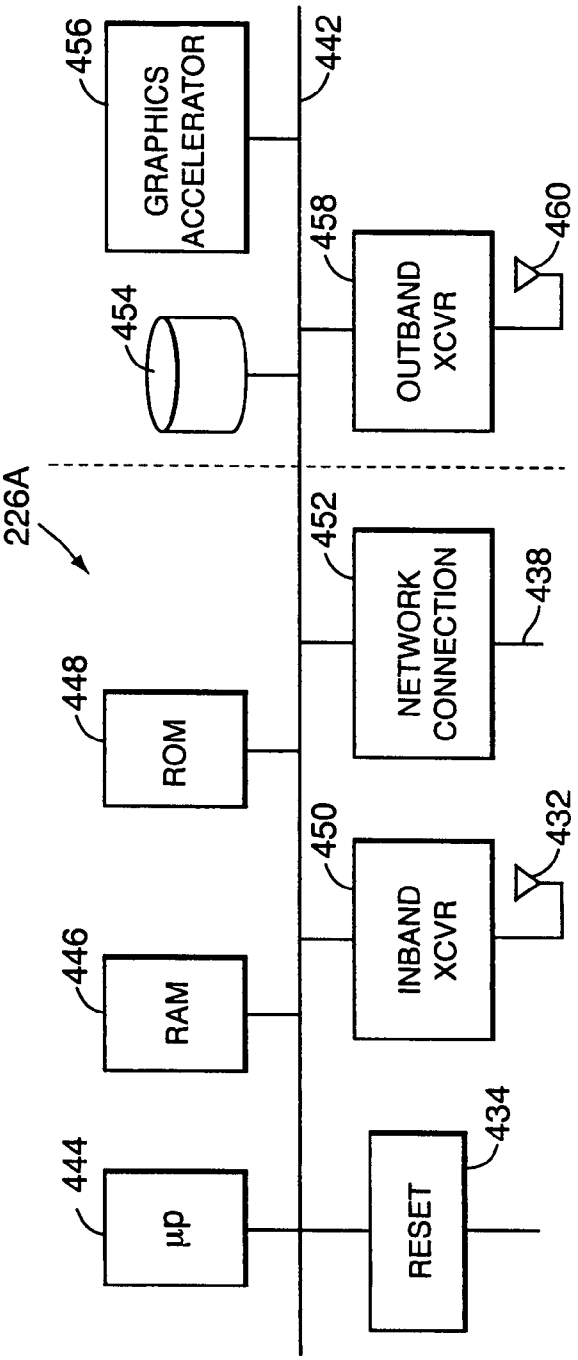
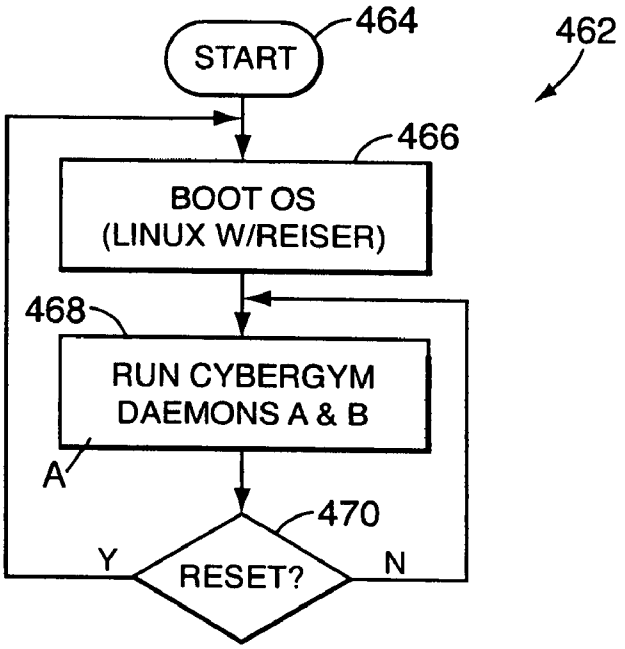

456
GRAPHICS ACCELERATOR
442
458
460
454
OUTBAND XCVR
226A
452
NETWORK CONNECTION
438
448
ROM
450
432
INBAND XCVR
446
RAM
434
444
µp
RESET

FIG. 21

FIG. 22


462
464
START
466
BOOT OS
(LINUX W/REISER)
468
RUN CYBERGYM
DAEMONS A & B
A
470
RESET?
Y
N

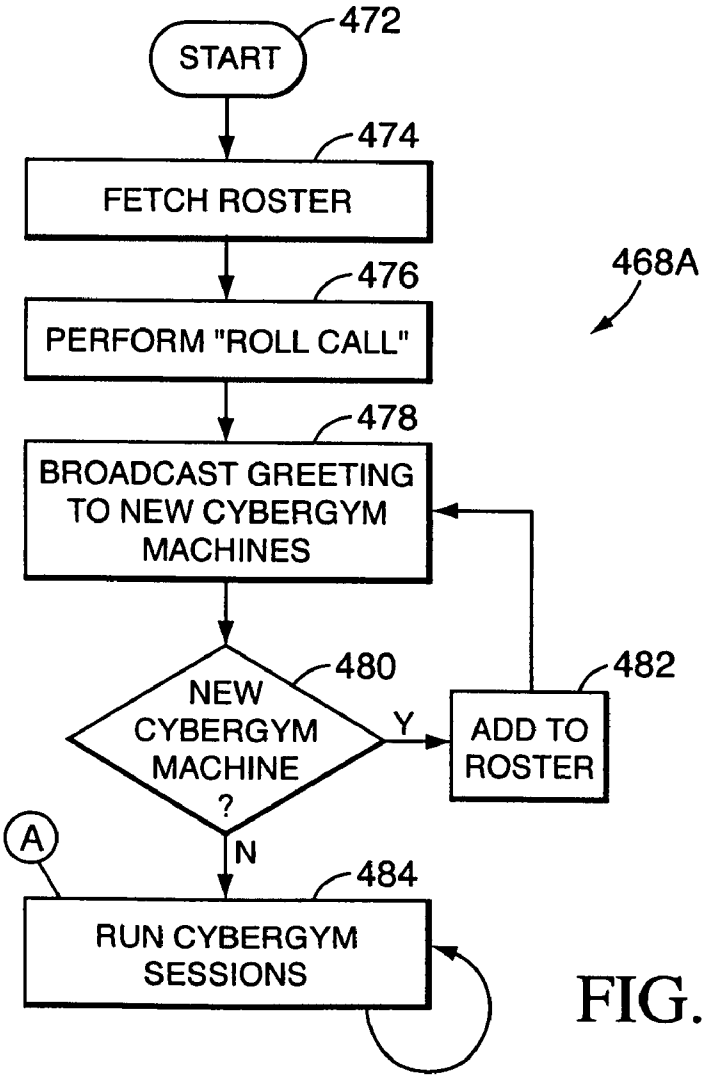

472
START
474
FETCH ROSTER
476
PERFORM "ROLL CALL"
468A
478
BROADCAST GREETING
TO NEW CYBERGYM
MACHINES
480
NEW
CYBERGYM
MACHINE
?
Y
482
ADD TO
ROSTER
N
A
484
RUN CYBERGYM
SESSIONS

FIG. 23

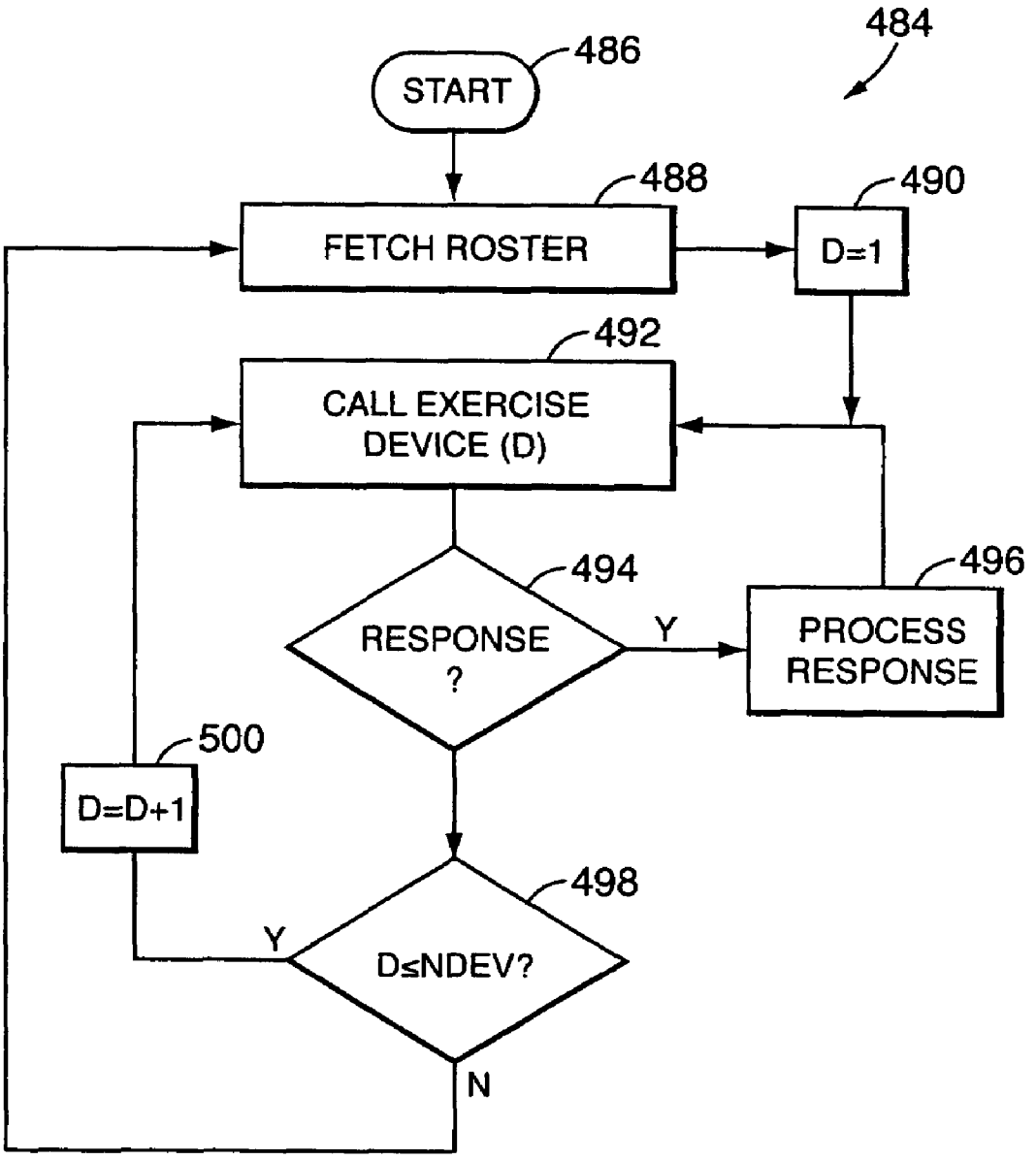
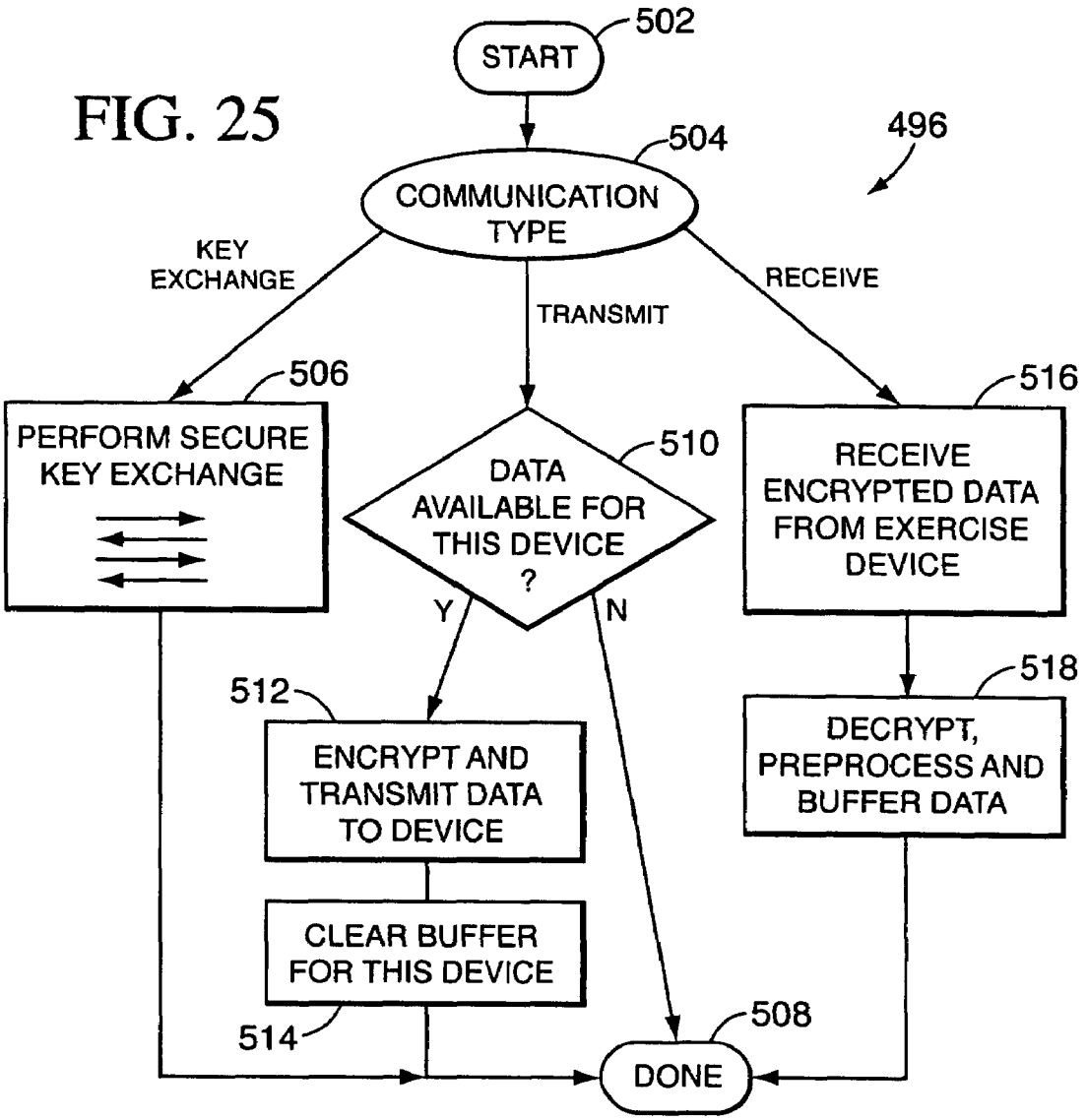

484
START
486
FETCH ROSTER
488
D=1
490
CALL EXERCISE DEVICE (D)
492
RESPONSE ?
494
Y
PROCESS RESPONSE
496
D=D+1
500
D≤NDEV?
498
Y
N

FIG. 24

FIG. 25



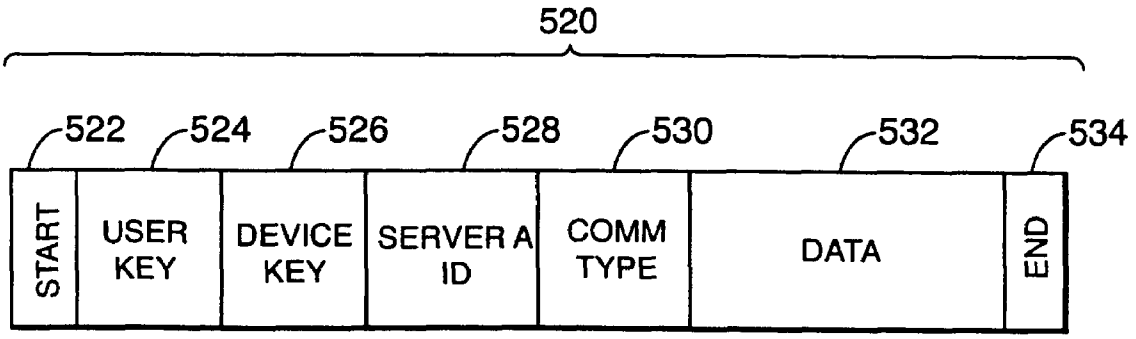


FIG. 25A

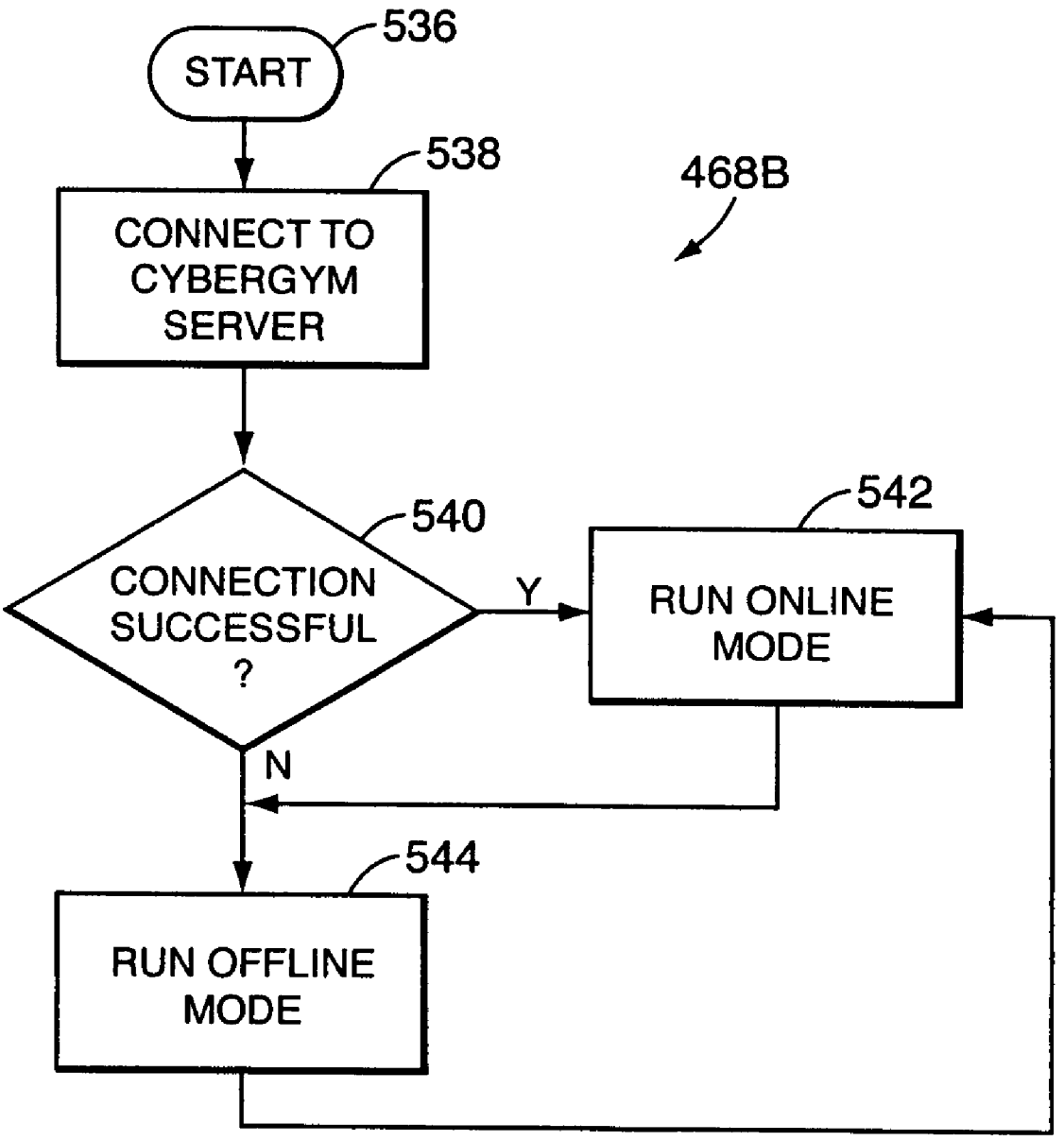

536
START
538
CONNECT TO CYBERGYM SERVER
468B
540
CONNECTION SUCCESSFUL ?
Y
542
RUN ONLINE MODE
N
544
RUN OFFLINE MODE

FIG. 26

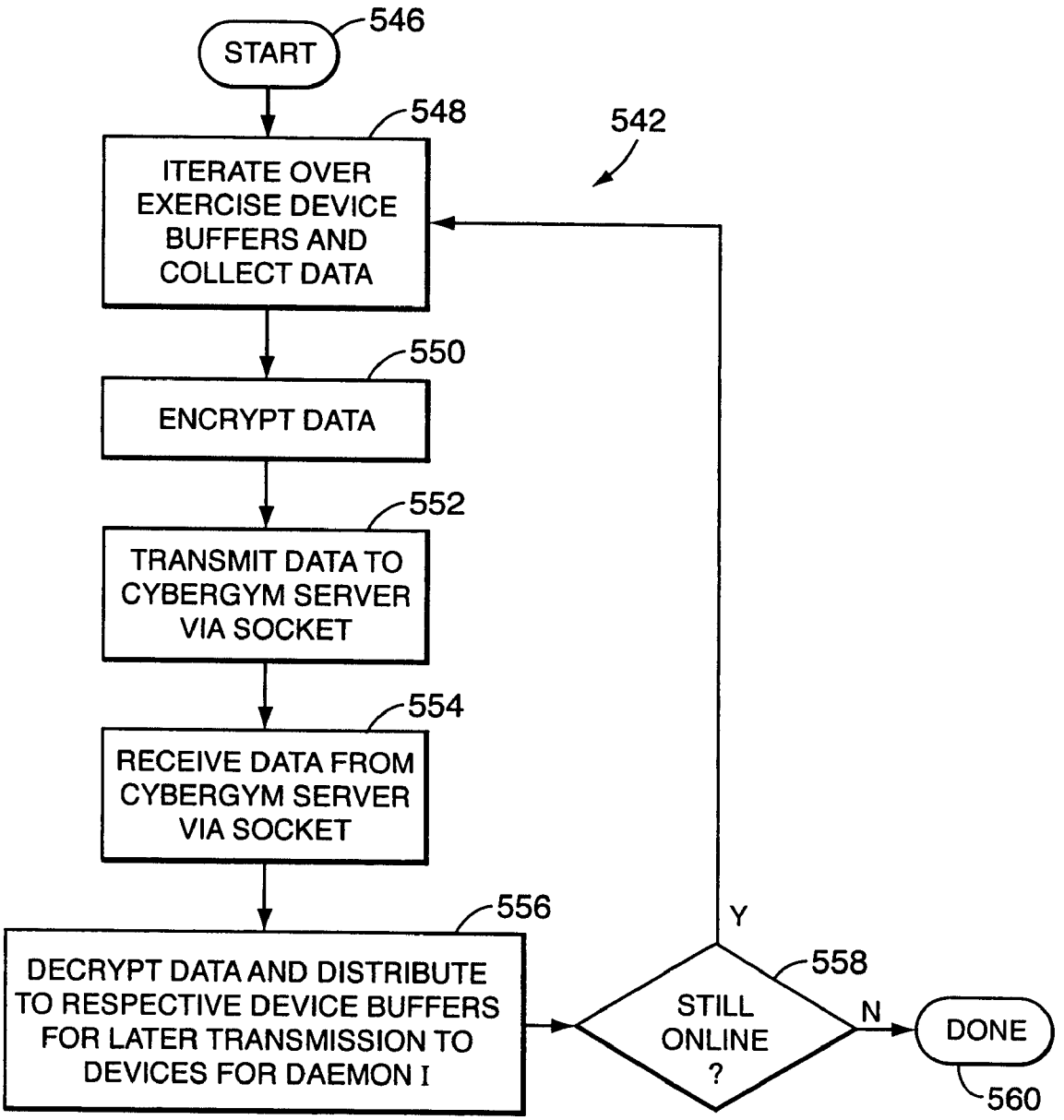

546
START
548
542
ITERATE OVER EXERCISE DEVICE BUFFERS AND COLLECT DATA
550
ENCRYPT DATA
552
TRANSMIT DATA TO CYBERGYM SERVER VIA SOCKET
554
RECEIVE DATA FROM CYBERGYM SERVER VIA SOCKET
556
DECRYPT DATA AND DISTRIBUTE TO RESPECTIVE DEVICE BUFFERS FOR LATER TRANSMISSION TO DEVICES FOR DAEMON I
Y
558
STILL ONLINE ?
N
DONE
560

FIG. 27

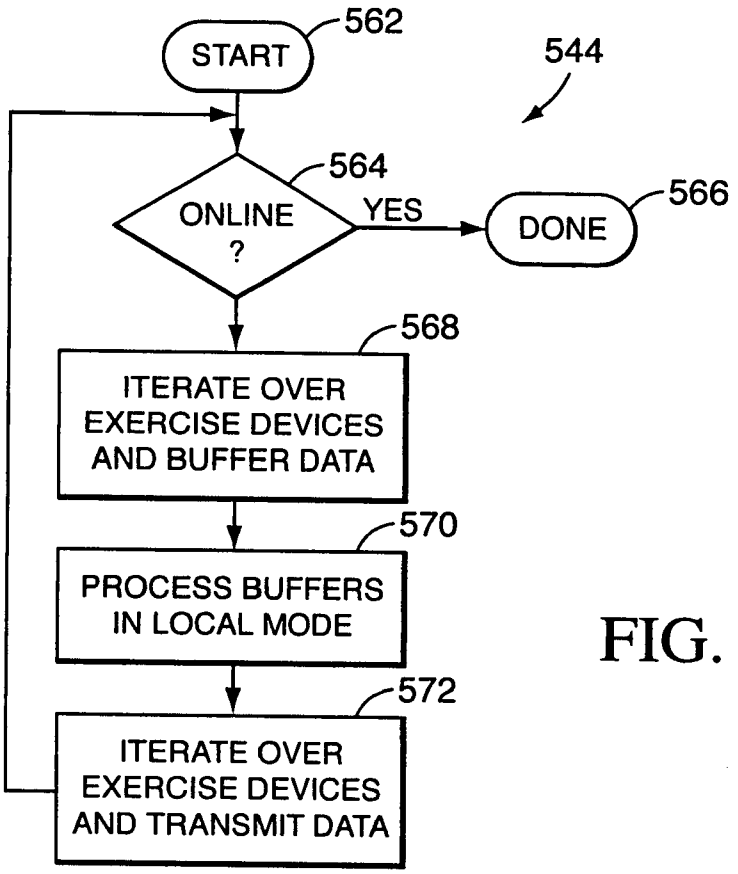


FIG. 28

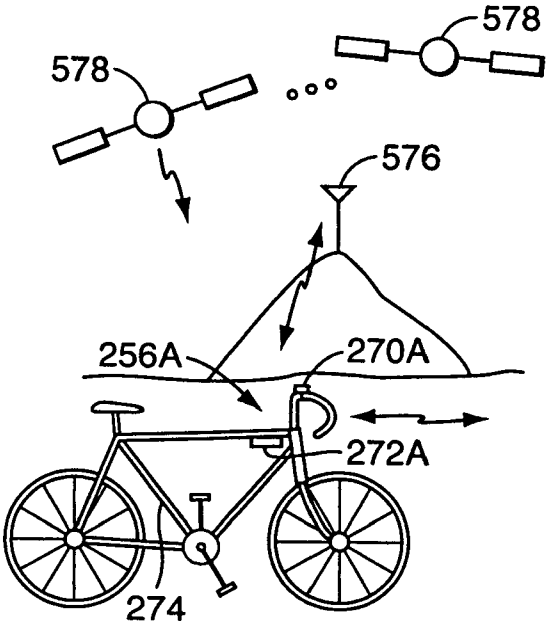


FIG. 29

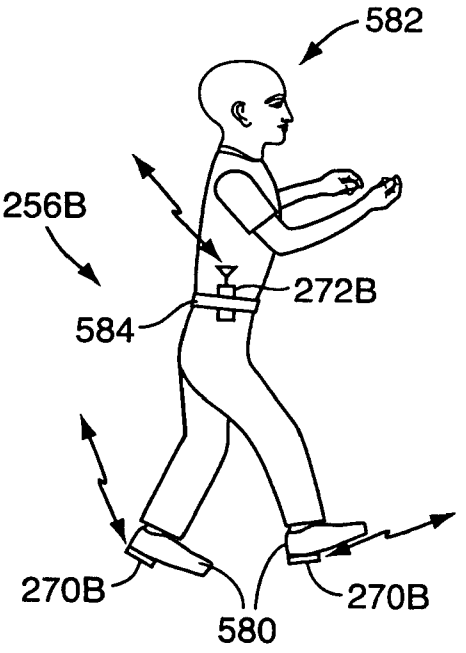


FIG. 30

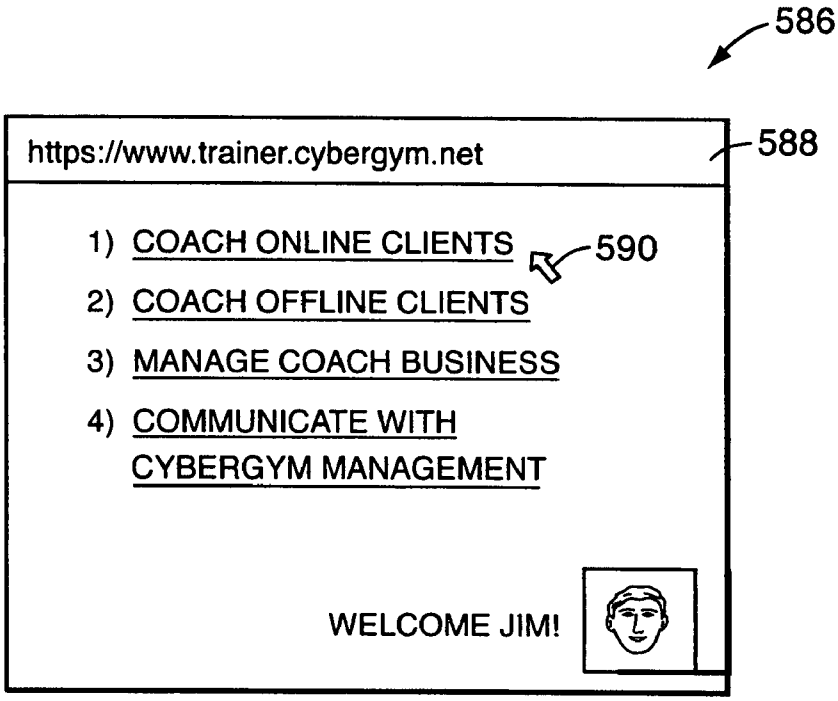

586
https://www.trainer.cybergym.net
588
1) COACH ONLINE CLIENTS
590
2) COACH OFFLINE CLIENTS
3) MANAGE COACH BUSINESS
4) COMMUNICATE WITH CYBERGYM MANAGEMENT
WELCOME JIM!

FIG. 31

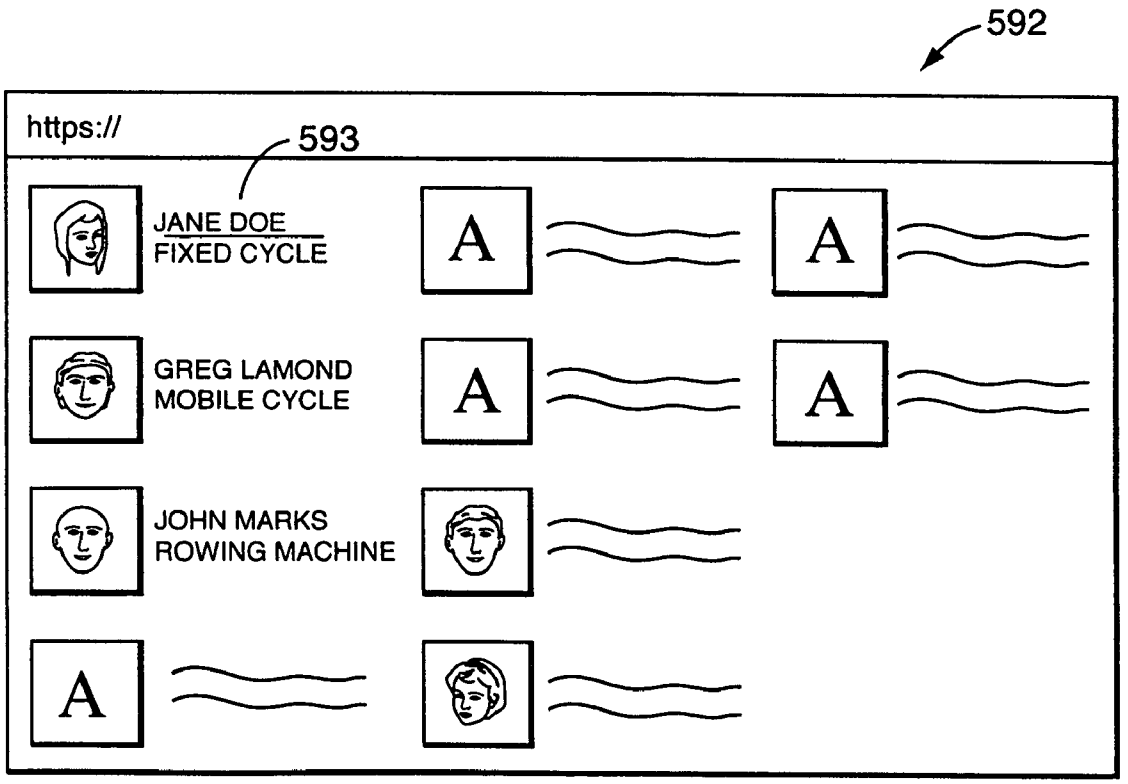

592
https://
593
JANE DOE
FIXED CYCLE
GREG LAMOND
MOBILE CYCLE
JOHN MARKS
ROWING MACHINE
A

FIG. 32

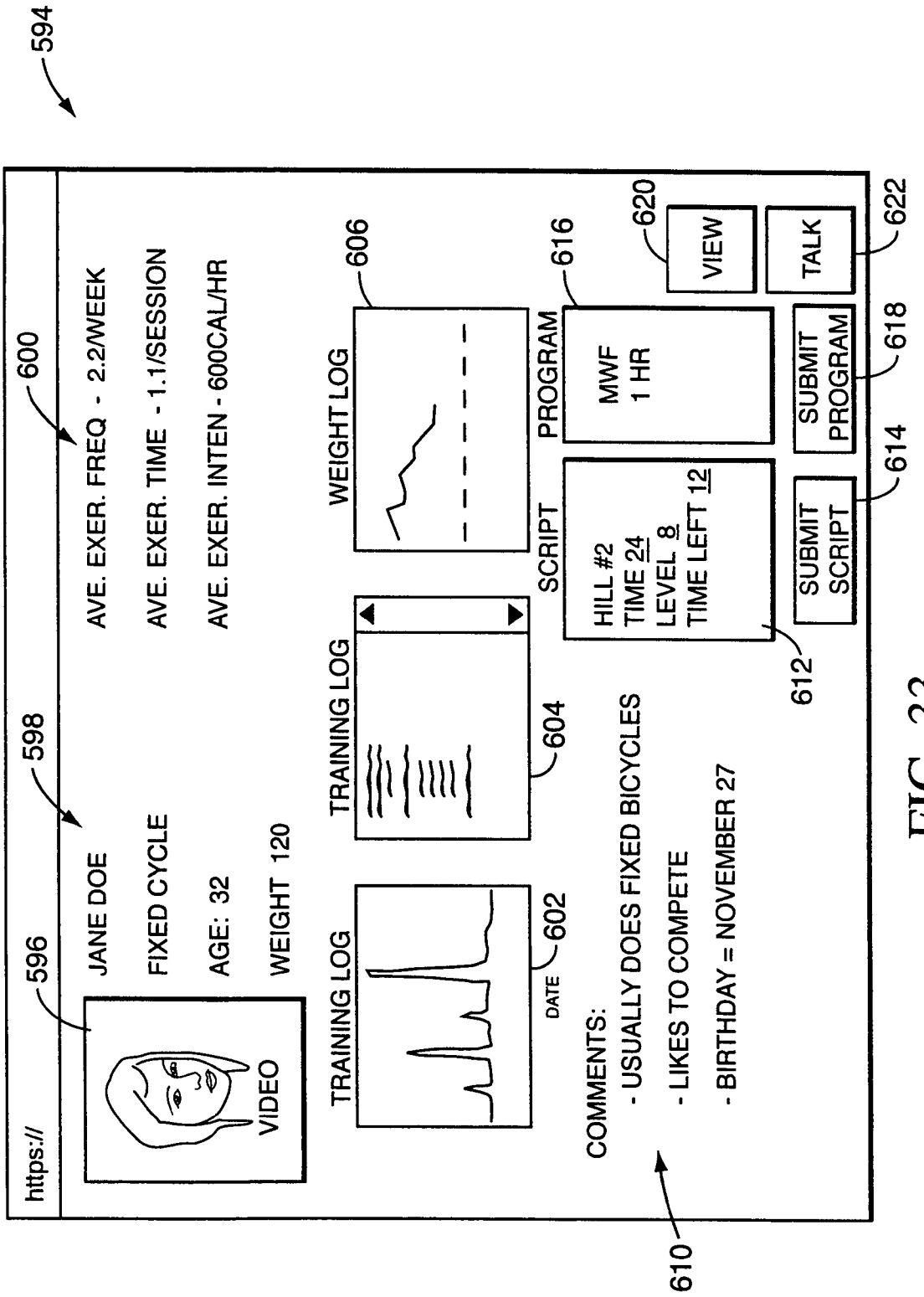

594
600
https://
596
598
JANE DOE
FIXED CYCLE
AGE: 32
WEIGHT 120
VIDEO
AVE. EXER. FREQ - 2.2/WEEK
AVE. EXER. TIME - 1.1/SESSION
AVE. EXER. INTEN - 600CAL/HR
TRAINING LOG
DATE
602
TRAINING LOG
604
WEIGHT LOG
606
COMMENTS:
- USUALLY DOES FIXED BICYCLES
- LIKES TO COMPETE
- BIRTHDAY = NOVEMBER 27
610
SCRIPT
HILL #2
TIME 24
LEVEL 8
TIME LEFT 12
612
PROGRAM
MWF
1 HR
616
SUBMIT SCRIPT
614
SUBMIT PROGRAM
618
VIEW
620
TALK
622

FIG. 33

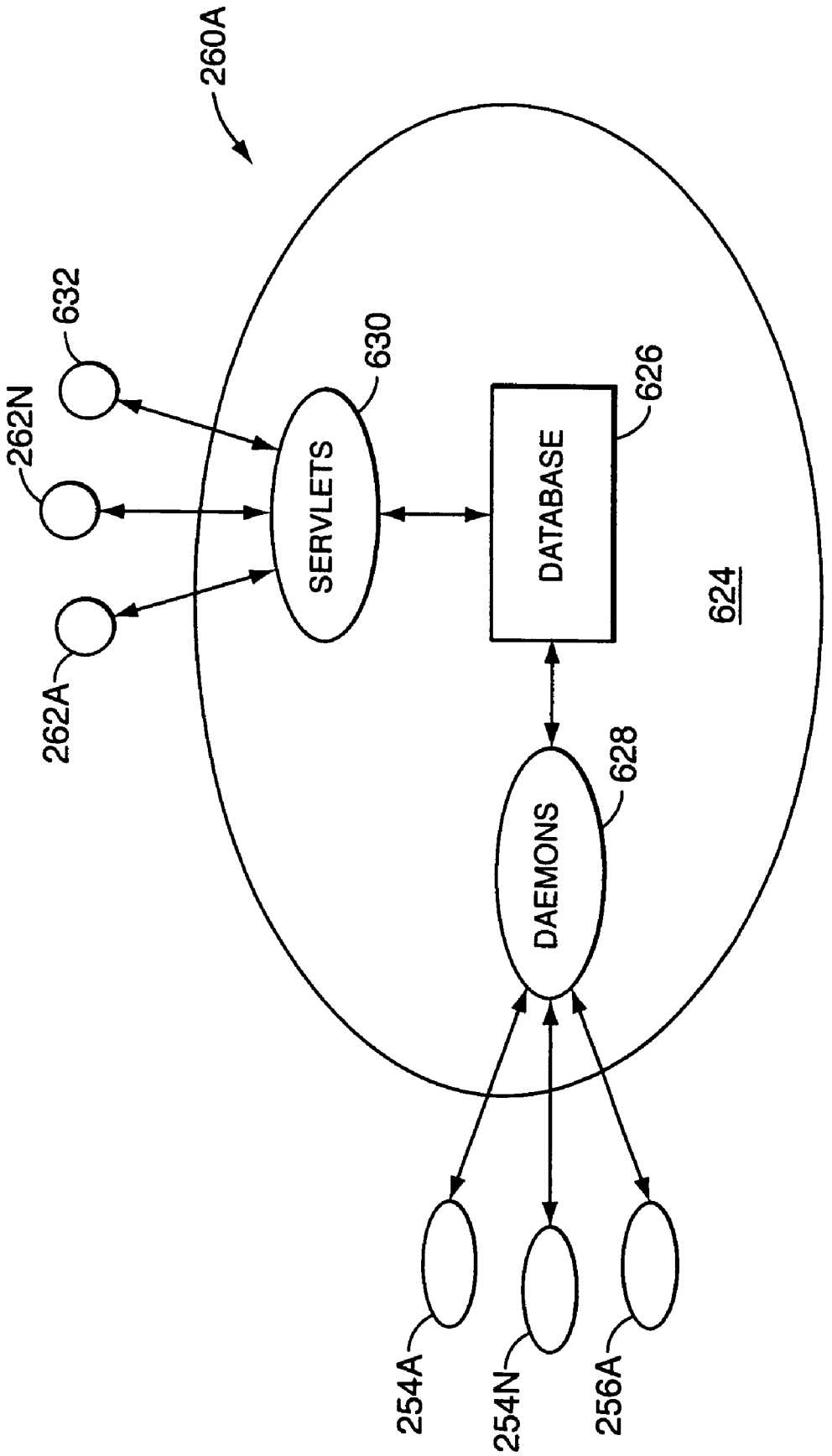

260A
632
262N
630
626
SERVLETS
DATABASE
624
262A
628
DAEMONS
254A
254N
256A

FIG. 34

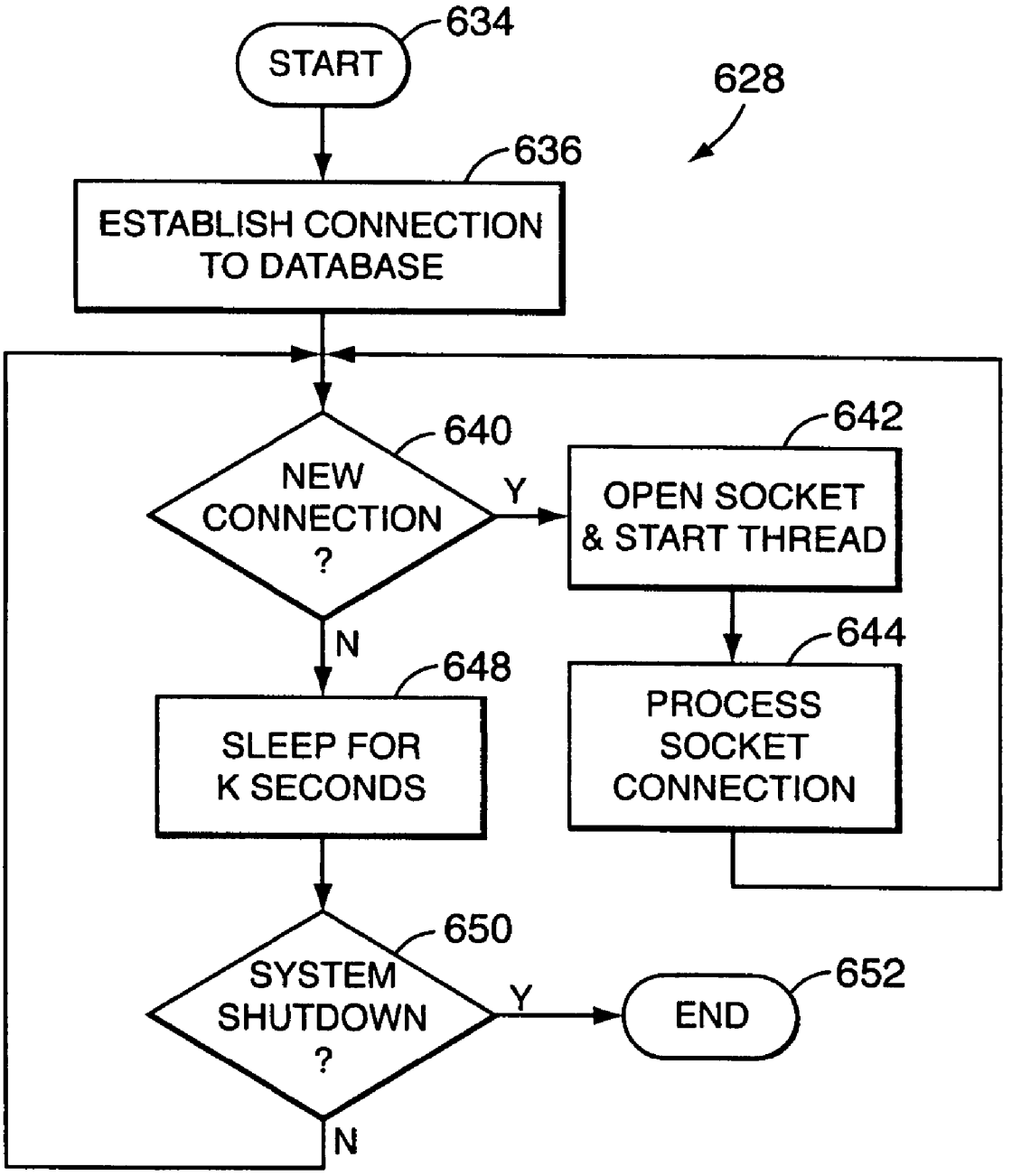

START
634
628
636
ESTABLISH CONNECTION TO DATABASE
640
NEW CONNECTION ?
Y
642
OPEN SOCKET & START THREAD
644
PROCESS SOCKET CONNECTION
N
648
SLEEP FOR K SECONDS
650
SYSTEM SHUTDOWN ?
Y
652
END
N

FIG. 35

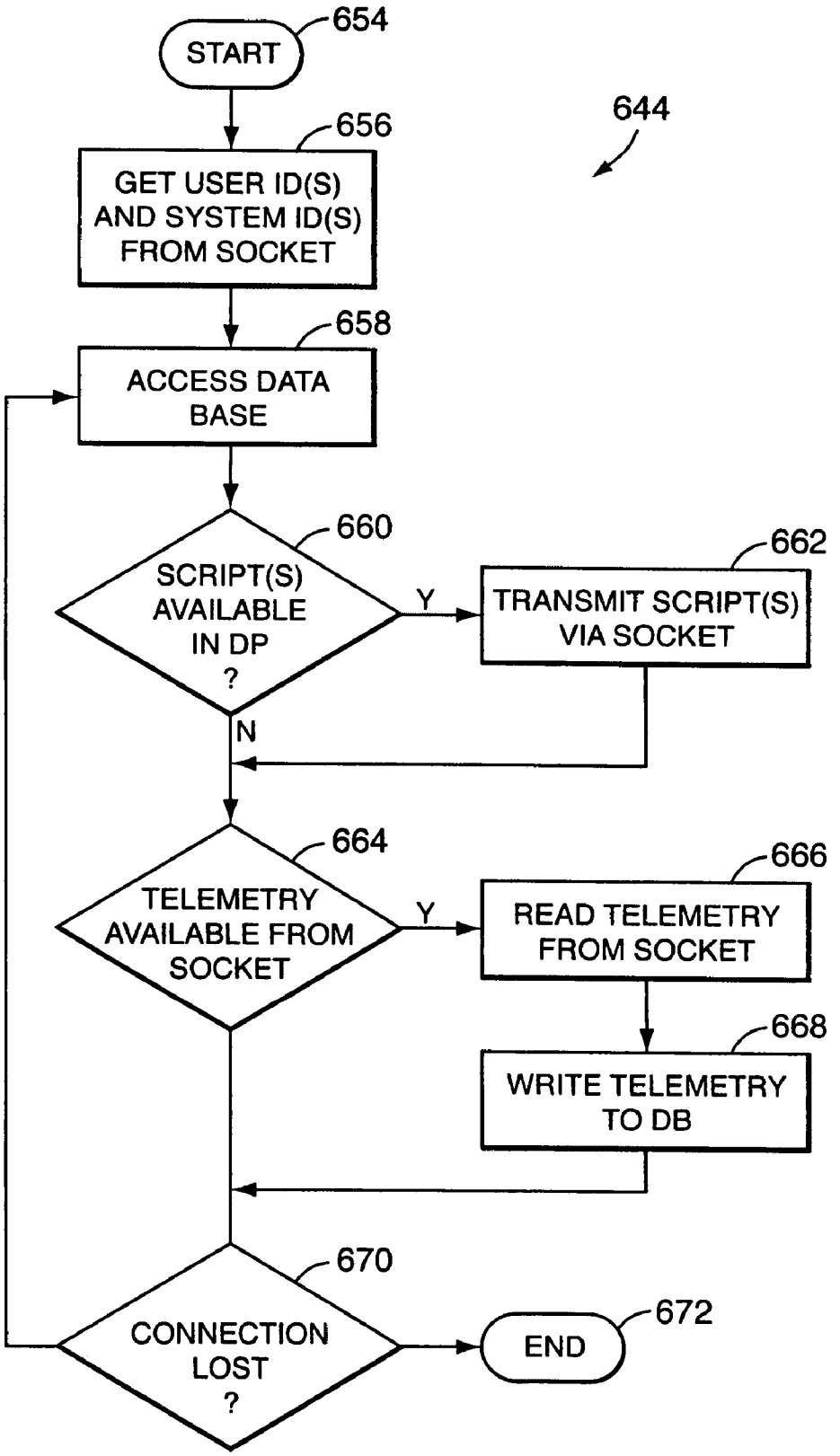

654
START
644
656
GET USER ID(S) AND SYSTEM ID(S) FROM SOCKET
658
ACCESS DATA BASE
660
SCRIPT(S) AVAILABLE IN DP ?
Y
662
TRANSMIT SCRIPT(S) VIA SOCKET
N
664
TELEMETRY AVAILABLE FROM SOCKET
Y
666
READ TELEMETRY FROM SOCKET
668
WRITE TELEMETRY TO DB
670
CONNECTION LOST ?
672
END

FIG. 36

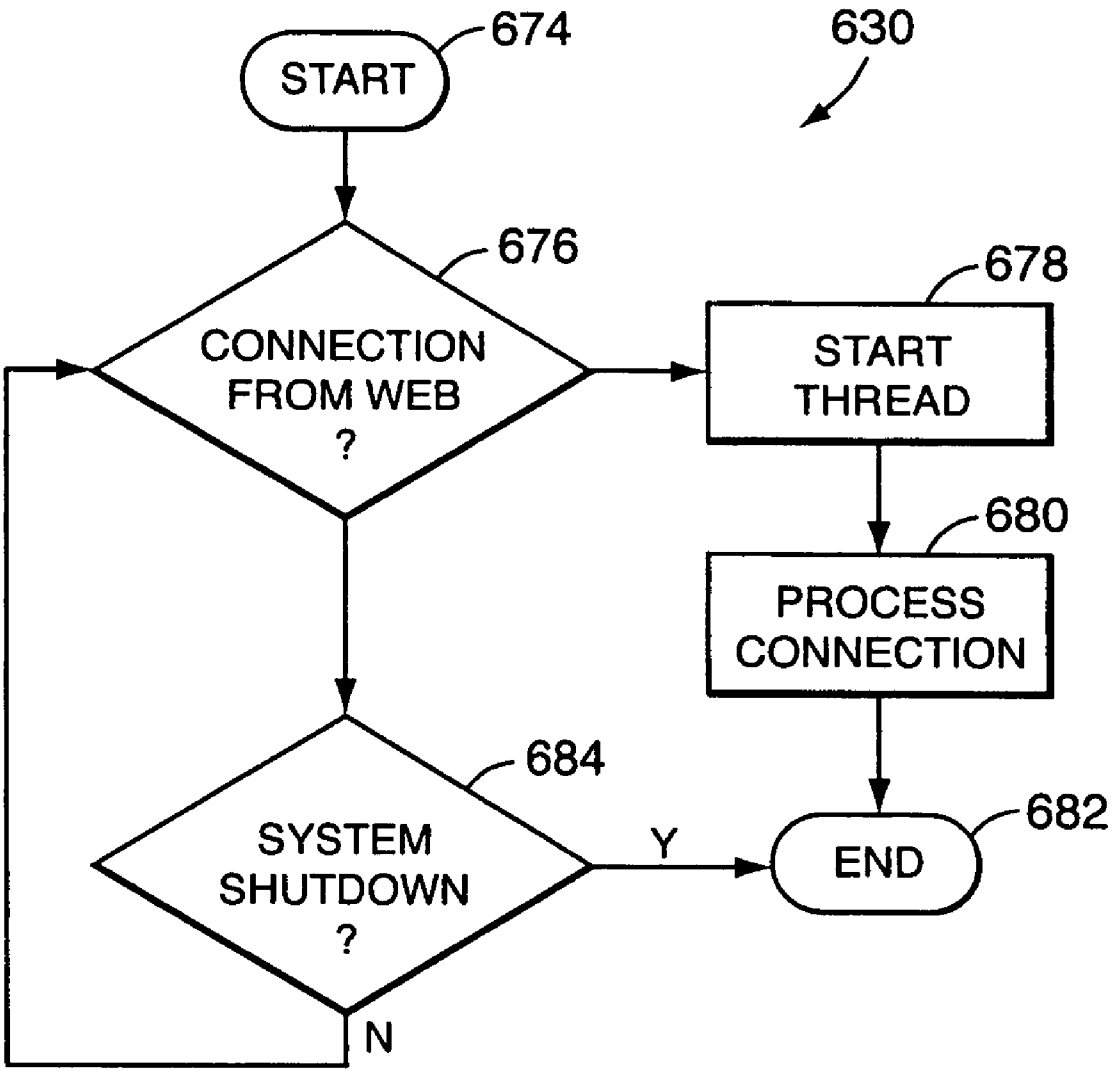

630
674
START
676
CONNECTION FROM WEB ?
678
START THREAD
680
PROCESS CONNECTION
684
SYSTEM SHUTDOWN ?
Y
682
END
N

FIG. 37

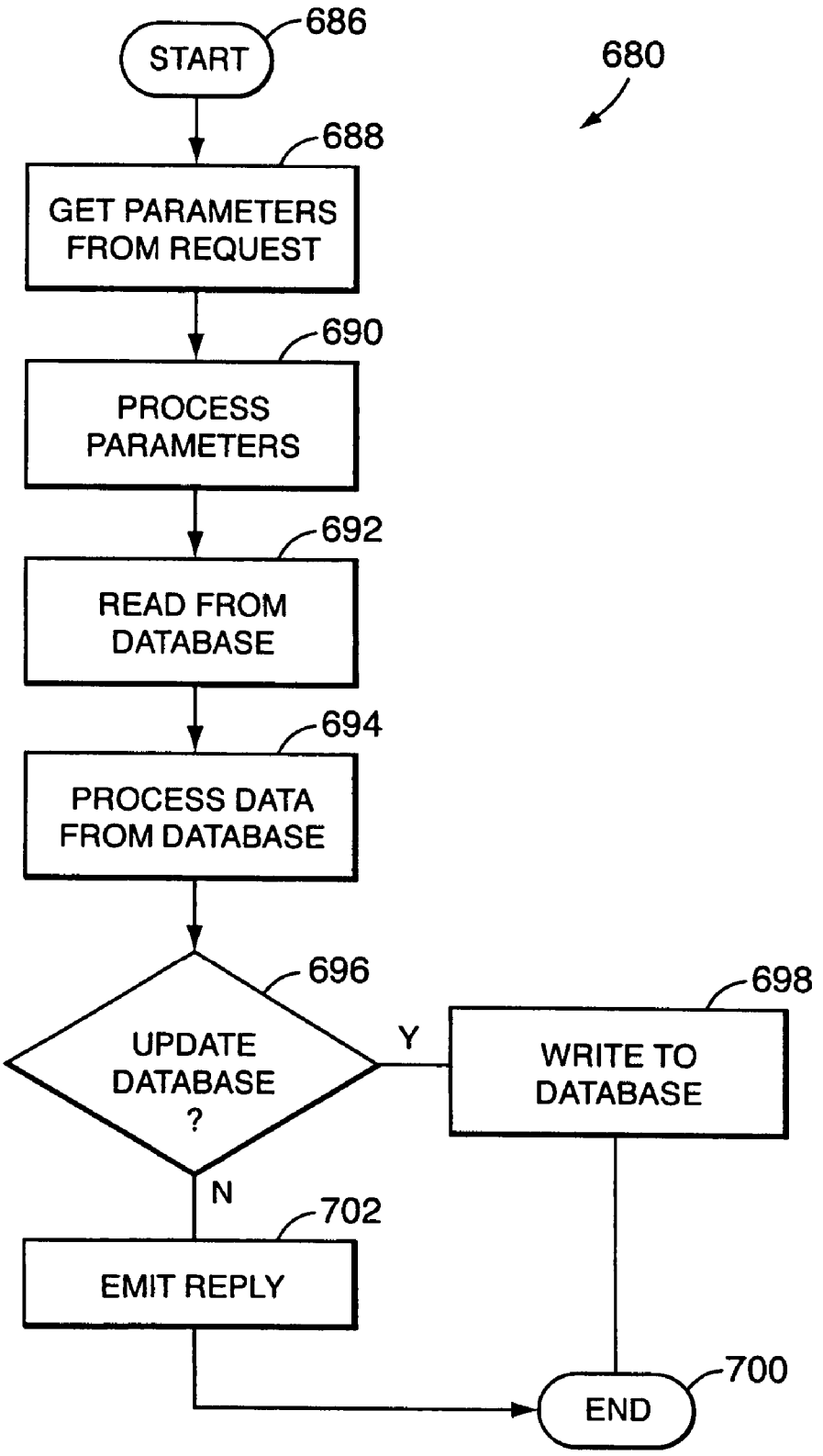

686
START
680
688
GET PARAMETERS FROM REQUEST
690
PROCESS PARAMETERS
692
READ FROM DATABASE
694
PROCESS DATA FROM DATABASE
696
UPDATE DATABASE ?
Y
698
WRITE TO DATABASE
N
702
EMIT REPLY
700
END

FIG. 38

MOBILE SYSTEMS AND METHODS FOR HEALTH, EXERCISE AND COMPETITION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Ser. No. 10/045,619, filed Oct. 19, 2001 now U.S. Pat. No. 6,921,351, incorporated herein by reference in its thek entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to health and exercise equipment, and more particularly to computer networked systems including health or exercise equipment.

2. Description of the Related Art

Good health is a fundamental requirement for a happy and long life. A multi-billion dollar health and fitness industry has grown to help individuals meet this requirement. For example, there are a great many gymnasiums which provide facilities and equipment for aerobic and musculature development, and there are hundreds, if not thousands, of weight loss and diet centers and programs. The goals of these many programs typically include weight loss and/or maintenance, the improvement of aerobic fitness, improved circulation, increased strength, and body building or shaping.

There are several problems encountered with the use of gymnasiums, fitness centers, and diet centers. For one, they tend to be fairly expensive due to the need to maintain the facilities, pay rent and payroll, buy equipment, etc. In addition, these centers tend to be inconvenient in that they require a special trip to the center by individuals wishing to use their facilities. Both the price and the inconvenience tend to discourage use of these centers over time, allowing the individuals to lose incentive and drop out of their fitness or diet program.

A partial solution to this problem is home exercise and health equipment. Again, a large industry has arisen to provide exercise and health equipment for the home. This equipment tends to be more of the aerobic type, e.g. stationary bicycles, rowing machines, "step" machines, etc., although weight lifting apparatus, sometimes referred to as "resistance trainers," are also widely used in the home. These types of home exercise and health equipment increasingly use sophisticated electronics, such as microprocessors, to monitor the level of exercise and to provide exercise programs for the user.

Unfortunately, even well designed home exercise and health equipment often fall into disuse over time. This is because individuals, even in their own home, often lack the incentive to exercise when there are other, more enjoyable, activities available. Also, since there is typically not the camaraderie often found in a health club, diet center, etc., it is easier for users, as individuals, to discontinue their exercise or diet program.

Personal trainers have been used both at fitness clubs and in the home. Personal trainers are individuals who usually have a fitness training background and who typically provide personal training services to an individual customers. Personal trainers can be very effective in that they provide personal motivation and feedback to an individual in the exercise program, and thus often foster a more effective and longer-lasting exercise program. The downside of personal trainers is, particularly in the home setting, their relatively high cost. It is not unusual for a personal trainer to charge hundreds of dollars per month for their services. Therefore, while these personal trainers are very effective, they tend to be used by only a small percentage of the population.

It is also desirable to make exercise more of a group experience. It is well established that people are more likely to exercise in a group setting than they are on their own. With stationary exercise equipment this, in the past, could only be accomplished by physically locating the exercise apparatus near to each other, e.g. in a health club setting. With mobile exercise equipment, the exercisers would have to group together, such as assembling a group for bicycle ride. In either case, the ability to share a group exercise experience required users to physically get together. Also, such group exercise experiences were typically limited to same-type exercise equipment. That is, bicycle riders rode with bicycle riders, swimmers swam with swimmers, etc.

Even the individual and group experiences within a gymnasium or health club can be somewhat lacking. The exercise equipment are typically stand-alone, without allowing for the gathering of exercise session parameters, interactivity, remote communications, etc. It would be desirable to have such experiences expanded with enhanced capabilities as well.

SUMMARY OF THE INVENTION

The present invention provides an exercise and health system which is convenient, affordable, and effective. The system includes computerized exercise and/or health equipment (the "local system") that can provide feedback and encouragement to the user, i.e. can serve as a "virtual personal trainer." These local systems often include a local server to service multiple exercise devices. In addition, the system includes a remote system communicating over a bi-directional data channel (preferably the Internet) with the exercise and health equipment. This remote system can include remote servers communicating with the local system, and remote work stations used by trainers and users to interact with the remote servers and local systems.

Since the exercise and health equipment can communicate with the user, it is possible for the health equipment to provide incentive and motivation to the user much in the same fashion as a human personal trainer. In addition, the health and exercise equipment can store data and other parameters concerning the exercise or other activities which can be used to monitor the progress and to vary the exercise program or script. In this way, the local system can serve as a "virtual personal trainer." The data and other parameters can also be stored in the local server and uploaded to the remote server. From there, the data and parameters can be processed and/or accessed from the workstations and the local systems.

The remote server is preferably associated with a number of local systems. The remote server can be considered to be the communication tool of a human personal trainer via a workstation, as opposed to the "virtual personal trainer" emulated by software in the local system. Further, the remote server can provide for competitions and group exercising between virtually any number of users in any number of locations. Some of the users may be in fixed locations (such as on a rowing machine or a stationary bicycle), while other users may be in mobile locations, such as bicyclists and joggers. With appropriate handicapping, a person on a stationary bicycle can race with a person on a road bicycle (or even join the Tour de France), or with a person on a rowing machine. Further, "virtual" competitions can be held wherein an exercise device represents, for example, a spaceship, such that the more energy expended by the user results in faster spaceship movement. Such "virtual" competitions may use

standard sensor of the exercise equipment to "steer" the spaceships. For example, a person on a fixed rowing machine could steer by pulling harder on one oar than another, or "fire" a missile by pushing forward on both oars. However, it is anticipated that various "out of band" signals may also be used to create a virtual competition.

In a preferred embodiment of the present invention, a distributed wide area network (WAN) such as the Internet is used to couple local servers, remote servers, and workstations together. Users at local systems can interact visually and even in a tactile manner with other users over the Internet. For example, a first user at a first local station can take a "virtual ride" with another user at a second local station through the Internet connection. Likewise, a remote "personal trainer" can interact with a user at a local station via the Internet communication linkage.

The systems, methods, and apparatus of the present invention therefore can provide an effective exercise, dietary, and health program for a great number of individuals. The computerized health equipment provides incentive and encouragement to stay in the program, due to the "virtual personal trainer" of the local system, the human personal trainer of the remote system, and by the various services provided by the enterprise as a whole as supported by the server systems, peer systems, etc. For example, a variety of services of products can be offered to the users of the system to further their health and fitness goals. In addition, the camaraderie of exercising with other users can be provided.

The described invention therefore creates a "virtual gymnasium" anywhere and everywhere it is desired. For example, exercise equipment within a traditional gymnasium or health club can interact with exercise equipment that is out of doors or in a home environment. Furthermore, multiple exercise equipment can communicate with a local server (in, for example, a home, gymnasium, or health club setting) for the gathering of exercise session parameters, providing user feedback, generating reports, etc.

It will be appreciated that implementations of the present invention are ubiquitous, appliance-like, and scaleable. In particular, by providing an inexpensive base controller for minimal "in-band" communications, the controller can be provided on virtually every exercise apparatus at minimal cost, leading to the ubiquitous nature of the invention. By providing "plug-and-play" functionality, the system becomes appliance-like. In the wireless embodiments of the local system, a compatible exercise device needs only be brought into proximity with a local server to become a part of the system. Further, the local server has an extremely simple base interface: a reset switch. Of course, additional interfaces such as a touch-screen video display can add further functionality. Finally, the system is scalable because the same base architecture can be used to couple from one piece of exercise equipment to many pieces of exercise equipment to the local and/or remote servers of the system.

These and other advantages of the present invention will become apparent upon the rating of the following descriptions and the study of the figures of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a health and fitness system in accordance with the present invention;

FIG. **2** is a block diagram of the local, remote, and server system computers of the present invention;

FIG. **3** is a flow diagram of a process running on a local system computer of the present invention;

FIG. **4** is a flow diagram of the "Process Exercise Activity" operation of FIG. **3**;

FIG. **5** is a flow diagram of the "Detect And Record User Activity, Provide Feedback" operation of FIG. **4**;

FIG. **6** is a flow diagram of a "Process Local System Activity" operation of FIG. **3**;

FIG. **7** is a flow diagram of the "Process Remote Activity" operation of FIG. **3**;

FIG. **8** is a flow diagram of a process running on a remote system computer of the present invention;

FIGS. **8***a*, **8***b*, and **8***c* are three examples of data analysis performed in the "Process Data" operation **176** of FIG. **8**;

FIG. **9** is a flow diagram of a process running on a server system computer of the present invention;

FIG. **10** is an illustration of a local system connected to other local systems, remote systems, and server systems via the Internet;

FIG. **11** is a block diagram of the local computer of the local system of FIG. **10**;

FIG. **12** is an illustration of a "virtual ride" taking place over the Internet with users using two separate local systems;

FIG. **13** is an illustration of a remote interactive exercise and health system in accordance with the present invention;

FIG. **14** is a block diagram of a preferred control circuitry for an exercise device of the system illustrated in FIG. **13**;

FIG. **15** is a block diagram of a preferred architecture for an interface of FIG. **14**;

FIG. **16** is a flow diagram of a process executed by the microprocessor of FIG. **15**;

FIG. **17** is a flow diagram illustrating the "Connect with Server?" process of FIG. **16** in greater detail;

FIG. **18** is a flow diagram illustrating the "Run Exercise Session" process of FIG. **16** in greater detail;

FIG. **19** is a flow diagram illustrating the "Execute Script" process of FIG. **18** in greater detail;

FIG. **20** is an illustration of a fixed local server of FIG. **13**;

FIG. **21** is a block diagram of the server illustrated in FIG. **20**;

FIG. **22** is a flow diagram of a process implemented by the microprocessor illustrated in FIG. **21**;

FIG. **23** is a flow diagram of the "Run Cybergym Daemon A" of FIG. **22**;

FIG. **24** illustrates the process "Run Cybergym Sessions" of FIG. **23** in greater detail;

FIG. **25** is a flow diagram illustrating the "Process Response" operation of FIG. **24** in greater detail;

FIG. **25**A is an illustration of a transmitted data packet in accordance with the present invention;

FIG. **26** is a flow diagram of the "Run Cybergym Daemon B" of FIG. **22**;

FIG. **27** is a flow diagram illustrating the "Run Online Mode" process of FIG. **26** in greater detail;

FIG. **28** is a flow diagram illustrating the "Run Offline Mode" process of FIG. **26** in greater detail;

FIG. **29** illustrates a first implementation of a mobile local server;

FIG. **30** is an illustration of a second local server of FIG. **13**;

FIG. **31** illustrates a web page that may be displayed on a trainer machine of FIG. **13**;

FIG. **32** illustrates another web page which may be displayed on the trainer machine for coaching online clients;

FIG. **33** is a web page that can be viewed on a trainer machine for coaching an individual client;

FIG. **34** is an illustration of a Cybergym™ server of the present invention;

FIG. **35** is a flow diagram illustrating the operation of the daemon of FIG. **34** in greater detail;

FIG. **36** is a flow diagram illustrating the "Process Socket Connection" operation of FIG. **34** in greater detail;

FIG. **37** is a flow diagram illustrating the servlet process of FIG. **34** in greater detail; and

FIG. **38** is a flow diagram illustrating the "Process Connection" operation of FIG. **37** in greater detail.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. **1**, a health and fitness system **10** in accordance with the present invention includes one or more local systems **12**, one or more remote systems **14**, and one or more server systems **16**. The local systems **12** are typically home-based systems designed for the promotion of the health and fitness of individual users within a family. The remote systems **14** may be home or business based, and are used as data gathering and storage stations, as well as communication stations, between a human personal trainer and users of local systems **12**. As will be discussed in greater detail subsequently, the remote system **14** is associated with a relatively large number of local systems **12**, e.g. a personal trainer with a remote system might be in communication with 100 or more individual users of local systems **12**. This is made possible, in part, by providing a "virtual personal trainer" at each of the local stations **12** to partially or fully replace the need for a human personal trainer at the local station. The server systems **16** can communicate with the remote systems **14** to provide server and control functions across the entire enterprise, i.e. over the entire system **10**. As also will be discussed in greater detail subsequently, the server system **16** is associated with a number of remote systems **14**.

The local system **12** includes one or more health or fitness devices such as a stationary bicycle **18**, a weight or "resistance trainer" **20**, a scale **22**, etc. Associated with a local system **12** is a computer **24** which, in this preferred embodiment, is integrated into the stationary bicycle **18**. A stationary bicycle as a "base unit" is given merely by way of example, as any piece of equipment (a rowing machine, a step machine, etc.) could house the computer **24**, or the computer **24** could be housed separately. The computer **24** can serve as a "local server" for other health and fitness devices at local system **12**, such as the weight trainer **20** and the scale **22**. Alternatively, a separate local server **26** can be used to control and/or support various devices in local system **12** via data and control lines **28**, and communicate with the remote system **14** via a telephone line **30** and a modem **32**. However, in the present preferred embodiment, the assumption is that the local server **26** and modem **32** are not required and that the computer **24** will serve not only to control the operation and data gathering function of the stationary bicycle **18**, but will also provide these functions for the weight trainer **20** and the scale **22**. Of course, the weight trainer **20** and the scale **22** may include their own computer systems for local control purposes.

The stationary bicycle **18** includes a housing **34** which, as stated previously, preferably houses the computer **24**, a crank **36** provided with a pair of pedals **38**, a seat **40** supported by a seat stem **42**, handle bar **44** supported by handle bar stem **46**, legs **48**, and feet **50**. The various components of the stationary bicycle **18** are typically attached to a rigid frame that is internally connected to the housing **34**.

The weight trainer **20** is preferably a resistance-type weight trainer, such as a bench press machine, a biceps curl machine, a squat machine, etc. Typically the use grasps a bar connected to a cable that is attached to a resistance device. This resistance device can be weights, or can be an active resistance device such as a motor, or a passive resistance device such as an electrically actuated brake. Active resistance devices are advantageous in that they can provide a force-feedback that can closely mimic real-world conditions, i.e. the actual forces that might be felt by a user when lifting real weights with a human "spotter" or trainer. In any event, the amount of resistance to movement of the bar (or other portions of a piece of exercise equipment) is preferably under the control of the computer **24** and the script that it is running. Particularly with active resistance devices, the control by the local computer is important. This is because a tight feed-back loop between sensors and actuators (such as motors, solenoids, etc.) is desirable to create realistic force feed-back. This would be difficult to accomplish in a realistic manner over a communication linkage, unless such a linkage were extremely fast. However, even in the case of an extremely fast communication linkage, the performance of a remote computer would likely diminish as it was attempting to control even one local system, let alone many local systems. The scale **22** preferably provides an electrical connection to the computer **24** through an I/O port to allow the computer **24** to monitor the weight of the person standing on the scale.

The computer **24** is coupled to a variety of input/output (I/O) devices including a brake **52**, a sensor **54**, a display **56**, a heart rate monitor (HRM) **59**, a loudspeaker **58**, an interface **60**, a modem **62**, and a voice board **64**. In this fashion, the computer **24** can control and monitor the various functions of the stationary bicycle **18**.

More particularly, computer **24** can, under software and hardware control, control the electrically actuated brake **52** which is coupled to the crank **36** of the stationary bicycle. In this fashion, the pedaling force that must be exerted on pedals **38** to cause the crank **36** to rotate at a given speed can be varied under computer control. This electrically actuated brake can be electric/mechanical brake, electric/magnetic brake, etc. as it is well known to those skilled in the art. The brake **52** can be passive (i.e. one that creates a frictional, magnetic or other drag) or active (e.g. a motor/generator that resists the movement of the crank **36**). The sensor **54** is typically used to determine the rotations-per-minute (RPM) of the crank **36**. In this way, the computer **24** can receive information concerning the level of effort being exerted by a user of the stationary bicycle **18**. Rotation sensors are well known those skilled in the art. The sensor **54** can also measure other parameters such as the force (torque) being applied to pedal **38**, again to provide information to the computer as to the level of effort being exerted by the user of the bicycle.

The computer can provide an output on a display **56** that can be viewed by an individual user sitting on seat **40**. This display can be a simple light display, e.g. a series of light emitting diodes (LEDs) or it can be a full video display. A preferred embodiment of the present invention provides a full video display to provide instructions and encouragement to a user of the stationary bicycle. For example, an image of a "virtual personal trainer" can be provided on the video display **56**. This image is preferably the image of the human personal trainer who is in charge of the remote system **14**.

The loudspeaker **58** provides another important communication medium to the user of the stationary bicycle **18**. For example, under computer **24** control, the user can be told with either a digitally synthesized or digitally recorded voice to pedal faster, pedal slower, that they are doing a good job, etc. Of course, analog recording techniques can be used as well, but are considered to be less flexible and desirable. Preferably, the voice being used is that of the personal trainer associated with the remote system **14** that oversees that local

system **12**. Both voice synthesis and digital voice recording on computer systems **24** are well known to those skilled in the art.

A local interface **60** can be used to couple the computer **24** to additional health and fitness devices. In this instance, the local interface **60** is coupled to the weight trainer **20** and to the scale **22**. This additional health and fitness systems can either "dumb" systems with limited digital computation and storage capabilities, or they can include full fledged computer system such as the computer system **24**. In the present embodiment, the weight trainer **20** and scale **22** include digital control circuitry (e.g. a microcontroller) which can communicate with the more powerful computer **24** of the stationary bicycle **18**. The various I/O devices, such as the loudspeaker **58** can be used in conjunction with these other devices **20** and **22**, e.g. the weight detected by the scale **22** can be announced on the loudspeaker **58** along with an indication that this is an increase or decrease in weight from the last session. Also, as mentioned previously, the weight trainer **20** can include the equivalent of the electrically controlled brake **52** which allows the resistance of the weight bar or handle to be varied to provide resistance ("weight") training. This control of the brake within the weight trainer **20** can be controlled by a "script" of the computer **24**.

The computer **24** is also coupled to a modem **62** for communication over a telephone line **30**. Alternatively, the computer **24** can be coupled to the remote computer **14** by other communication linkages, such as ISDN digital transmission line, via a local area network, or via a wide area network (WAN) such as the Internet. In other words, the telephone line **30** represents only one type of data communication channel between the local systems **12** and the remote system **14**. The Internet, which has been growing rapidly in popularity, is a particularly good communication linkage due to its ubiquitousness, power, and flexibility. As will be appreciated by those skilled in the art, the Internet is one form of distributed packet network where data is broken into packets which can travel along a multitude of paths between source and destination. The Internet (and private networks known as Intranets) are packet networks operating on the well-known TCP/IP protocols.

The present embodiment also includes a voice board **64** which can bypass the modem such that the loudspeaker **58** can be driven directly to the telephone line **30** in an analog fashion. Combination modem/voice boards are commercially available for personal computer systems, and are well known to those skilled in the art.

The remote system **14** includes, for example, a remote system computer **66** which is coupled to the telephone line **30** by a modem **68**. In addition, a telephone **70** can be coupled to the line **30** by a voice board **72**. Alternatively, the telephone **70** can be coupled to a separate telephone line so that simultaneous telephone and data links can be made. Still further alternatively, it is known to those skilled in the art that a single telephone line can be made to support both voice and data transmission. In any event, the telephone **70** can communicate directly with the loudspeaker **58** of the stationary bicycle **18** over the standard analog telephone line **30**. Alternatively, the telephone **70** can communicate with the computer **66** as indicated by the broken line **74** and the computer **66** can communicate digital voice data via modem **68**, telephone line **30** and modem **62**, to the computer **24**. The computer **24** can then store or pass through the digital voice data and play the voice input to the user of local station **12** via speaker **58**.

As noted above, the computer **66** is used to communicate with the local system **12** via computer communication link or "transmission medium" such as the telephone line **30** or an equivalent. This communication can include the downloading of data and instructions to the computer **24**, and can include the uploading of information from the computer **24** to the computer **66**. This allows for interactive communication between the remote system **14** and the local systems **12**.

The server stations **16** are used to further consolidate information from multiple remote system **14** and to provide a variety of services to the remote systems **14**. While the remote system **14** may be housed in human personal trainer homes or work sites, the server system(s) **16** are preferably more regional or national in origin. In this way, the main office of the enterprise can access each of the server systems **16** to provide upgrades for software, exercise programs, exercise equipment scripts, etc., as well as receiving information from the remote computers **66** that can be used for further analysis and for providing further services. Part of this analysis can be on the general and specific level of fitness of various individual users of the local system **12**, as well as marketing information that can be used to offer product and services particularly tailored for the various users of the local system **12**. The performance of the human personal trainers at remote stations **14** can also be monitored. It should be noted that the server **16** can include direct connect server **76** and peer server **78** that can either be direct server itself (like server **76**) to a number of remote stations **14**, or which can be a specialized server (such as a dietary analysis server) coupled to one or more direct connect servers **76**. In addition, higher-level servers can be used to further consolidate data from the direct connect servers **76** and/or the peer servers **78**. For example, the direct connect servers **76** can be regional in scope, while higher level servers can be national or international in scope.

In FIG. **2**, a computer **80** is shown in a block diagram form. This basic computer architecture can be used for the local system computer **24**, the remote system computer **66**, and the server system computer **76**. Of course other and equivalent architectures (in the computational sense), such as parallel processing computers can be used in the present invention as well. In the disclosed embodiment, the computer **80** includes a microprocessor **82**, random access memory (RAM) **84**, read only memory (ROM) **86**, real time clock (RTC) **87**, digital mass storage **88**, CD-ROM drive **89**, and a number of input/output (I/O) ports **90**. Preferably, the digital mass storage **88** is read/write memory such as a hard disk with adequate storage capacity (e.g. 40 megabytes to 2 gigabytes or more). In addition, CD-ROM drive **89** can be coupled to the bus to provide, in particular, images to be displayed on a display **56** of the local system **12**. The various components **82-90** address, pass data, and pass control signals through a bus **92** which typically includes data (D), address (A), and control (C) lines, as it is well known to those skilled in the art. In addition, there are control and "glue" chips typically provided in the form of a "chipset" which are used to couple the various components of the system together. The design and manufacture of computer systems such as computer system **80** is well known to those skilled in the art, and such computer systems are commercially available, both as complete systems and as subsystems (e.g. motherboards) from a variety of commercial sources.

In FIG. **3**, a process **94** implemented on a local system computer **24** is illustrated in a flow diagram. The process begins at **96** and, in a decision operation **98**, it is determined whether there is any activity which requires the attention local system computer. If not, the computer system **24** is in a "standby" mode and process control is returned to operation **98** in a recurring manner. If operation **98** does determine that there is some activity, one or more of multiple branches are made to process the activity. If the activity is "Exercise", e.g.

the stationary bicycle **18**, the weight trainer **20**, or the scale **22** is to be used, an operation **100** processes the exercise activity. If it is a "Local System" activity such as routine housekeeping, the local system activity is processed in an operation **102**. If it is a "Remote System" activity, the remote system activity is processed in an operation **104**. After the completion of any one of steps **100**, **102**, and **104**, process control is returned to operation **98**. Of course, other types of activities can be initiated by operation **98** such as, for example, a shut down activity which would cause a power-down of system, as will be appreciated by those skilled in the art.

In FIG. **4**, operation **100** of FIG. **3** is illustrated in greater detail. The process **100** begins at operation **106** and, in an operation **108**, a "welcome greeting" is created. This welcome greeting can be displayed on the screen **56** and/or can be heard from the speaker **58**, and can be personalized to both the individual user of the local system **12** and the human personal trainer of remote station **14**. For example, the image of the personal trainer can show up on the screen **56** with his voice saying "Good morning, Fred! I haven't seen you since last Wednesday. Let's try to get in a good work-out today!" This greeting forms a part of a "virtual personal trainer" at local system **12** which replaces some or all of the need for a human personal trainer to be present at the exercise session at the local system **12**. The "virtual personal trainer" is, therefore, a computerized process which emulates part or all of the functions traditionally performed by a human personal trainer.

Next, in a selection operation **110**, the user decides whether he wants to select his own training program for that session or if he would like the system **12** to select the program. If the user selects the program, he creates a user "script" of what kind of exercise program he would like to perform that day. For example, if the user wishes to simply bicycle at a fixed resistance for thirty minutes, that can be entered in operation **112**. Alternatively, more complex "scripts" can indicate that he would like to bicycle with interval training for thirty minutes, and then do five repetitions on the weight trainer **20**.

If, however, the user allows the system **12** to select the section type, operation **114** controls the script selection. This is the preferred mode for using the local station **12** in that the script can be influenced not only by the local station **12**, but also by the human personal trainer at the remote system computer **66**. For example, data concerning the user's previous performances and the personal trainer's guidance can be stored in mass storage **88** (e.g. on a hard disk) so that a custom-tailored, interactive exercise program can be provided.

As noted above, the exercise program preferably proceeds according to "scripts." A script is simply a sequence of exercise or other health-related events that are performed in fixed or variable sequences. The order and structuring of the script can be modified based upon monitoring the user's performance or by other user feedback. For example, if it is detected that the user is getting tired due to a slowing of the exercise repetition rate, the operations or parameters of the exercise script can be modified accordingly. In other words, certain script steps can be skipped or the parameters concerning the steps can be modified. For example, if a user is determined to be tiring by the local system **12**, and if the script says the next exercise event is to be ten repetitions on the weight trainer **20**, that operation could be skipped. Alternatively, the weight training operation could still be done, but the resistance parameters could be modified. For example, instead of doing ten repetitions at a hundred pounds resistance on the weight trainer **20**, eight repetitions at eighty pounds of resistance might be called for. The script therefore provides a general framework of a desired exercise session which can be varied based upon human personal trainer input from remote system **14**, user input at local station **12**, and detected user performance at local station **12**.

Once the script has been initiated in either operations **112** or **114**, an operation **116** detects and records user activity and provides feedback to the user. This operation will be discussed in greater detail subsequently. Such parameters as the rotations per minute (RPM) of the crank **36**, the timing and speed of the resistance weight repetitions of weight trainer **20**, the detected weight on the scale **22**, etc. can all be recorded in the mass storage **88** of the local system computer **24**. In addition, user feedback is provided. For example, if the person is cycling too slow on the stationary bicycle **18**, the computer **24** can generate a encouragement on speaker **58** that the person should pedal faster. Alternatively, if it is determined that the user is over-exerting, such as pedaling too fast, a cautionary warning can be issued on speaker **58** to slow down. Another important input is the heart rate monitor (HRM) **59** which detects if the heart (pulse) rate is rising too high.

Next, in an operation **118**, it is determined whether the session is a modifiable session. Most sessions are preferably be modifiable, unless the user selects, in an operation **112**, a non-modifiable session. If the session is modifiable, the session is modified in an operation **120** based upon the selected script and upon user activity or other input. For example, if the heart rate monitor **59** detects that the pulse rate is too high, the resistance on the crank **36** can be reduced via a signal to the brake **52**. Next, in an operation **122**, it is determined whether the session is completed. This is usually based on the script, although the user can always terminate a session. If the session is not completed, process control is returned to operation **116** to repeat the loop. If the session is completed, the session records are updated in the mass storage **88**, as are the scripts, as indicated in operation **124**. The process **100** is then completed at operation **126**.

In FIG. **5**, the operation **116** of FIG. **4** is explained in greater detail. Process **116** begins at **128** and, in an operation **130**, exercise parameters relative to the script are stored, preferably in mass storage **88**. These parameters depend on the type of exercise being done, and the type of sensory input available to the system **12**, but typically includes such things as time, RPM, resistance, machine state, etc. These exercise parameters are used to control the implementation of the exercise script, and are stored for later analysis.

Next, in an operation **132**, it is determined whether encouragement is needed. An example of encouragement being needed is when the person is slowing down below the suggested repetition rate or speed in the script or, for example, has stopped exercising entirely. In such circumstances, encouragement is given in an operation **134**. Again, this encouragement can be auditory via speaker **58**, or visual via display **56**, a combination of the two, or in any other suitable fashion. Next, in an operation **136**, it is determined whether a caution is needed. If so, the caution is given in an operation **138** either through auditory, visual, or other ways. Caution might be needed if the user is exercising faster than that suggested by the script or if a dangerous physical condition is detected, such as by the HRM **59**. Next, in an operation **140**, it is determined if a script preview should be provided. If yes, an operation **142** provides an auditory, visual or other type of preview of upcoming script events. For example, the system **12** could be taking a user on a imaginary bicycle ride through the country. The script preview would then, in an operation **142**, indicate something like "We are now approaching a hill. You will note an increased resistance to pedaling in a few seconds which will steadily increase until we reach the crest

of the hill in about one and a half minutes." These operations **134**, **138**, and **142** are further examples of the local system **12** serving as a "virtual personal trainer." The process **116** is completed at operation **144**.

In FIG. **6**, operation **102** of FIG. **3** is illustrated in greater detail. Process **102** begins at operation **146** and, in an operation **148**, it is determined what type of local system activity is to be performed. Three different local system activities will be discussed herein by way of example. As a first example, the local system activity can be to alert the user as indicated in an operation **150**. For example, the local computer **24** can detect that it is time for a scheduled exercise session. The computer **24** can then communicate with the user via speaker **58** that it is time for a scheduled exercise. In this instance, the computer **24** would use a real time clock (RTC) **87** to know that it was time to initiate the exercise session. After completion of operation **150**, process control is returned to operation **148**.

A second type of local system activity would be housekeeping. For example, in an operation **152**, diagnostics can be run to check the operability and calibration of the various components of local system **12**. Also, in an operation **154**, data compression, hard disk compaction, and data preparation can be accomplished.

A third example of local system activity detected by operation **148** is a local communication within the local system **12**. For example, the weight trainer **20** or the scale unit **22** might be communicating to the computer **24** via the interface **60** or vice-versa. An operation **146** processes the data from the local unit accordingly and can provide commands to the local unit for the exercise or health session. Process control is then returned to operation **148** after the completion of operations **150**, **154**, and **156**.

In FIG. **7**, operation **104** of FIG. **3** is illustrated in greater detail. The process **104** begins at **158** and, in an operation **160**, the connection is established with the remote system. Next, in an operation **162**, information is uploaded or downloaded, the process is completed at **164**. It should be noted that the connection of operation **160** can be either an incoming connection or an outgoing connection. If there is an outgoing connection to a remote system computer **66** the modem **62** makes connection with the telephone line **30** and dials the telephone number of the remote system computer **66**. For an incoming connection, the modem **62** detects an incoming call on telephone line **30**, picks up the line, and connects to the local system computer **24**.

Since the systems **12** are typically home based, the user may wish to use a single telephone line for both normal telephone needs and for use by the system **12** for operation **160**. It would, of course, be simpler to have an additional telephone line installed simply for the system **12**, but this may be impractical from a cost point of view. If the system **12** is sharing the telephone line with the other telephones and devices in the household, mechanisms and/or processes are preferably provided to prevent interference with normal telephone usage. If the local system **12** initiates the call to the server **66**, it would simply need to detect whether the telephone line was available so as not to interfere with other use of the telephone line. It can help ensure this availability by calling at unusual times, such as the middle of the night or when it is known that the user is away from the home, e.g. at work.

However, with incoming calls from a computer **66** to the computer **24** on a single home line, some way of distinguishing between calls for the local system **12** and other kinds of telephone calls should be preferably provided. Again, this could be time-based such that it is implied that a telephone call in the middle of the night is for the local system **12**. The RTC **87** could be used for timing purposes in this situation, or the computer could simple start a counter. In this instance, the modem **62** would pick up the telephone quickly before other devices, such an answering machine for a facsimile machine, would have a chance to pick it up. Alternatively, the local system **12** could allow a number of "rings" before picking up the line. For example, the local system **12** could allow the telephone line **30** to ring six times before modem **62** picks up the line. In a still further instance, the computer **66** might be calling a local computer **24** and have the phone line picked up by the user or by another device (like a telephone answering machine) coupled to the telephone line **30**. In this instance, the computer **66** could hang up the line and call back a second time. Since the computer **24** can monitor the line via modem **62**, it could know that a call back within, for example, thirty seconds of a hang up is for the computer **24**. Alternatively, it could listen to the line on the first call to determine if it was computer **66** calling, and then pick it up the line **62** immediately on any call back, or call back the remote system computer **66** itself when the telephone line was free. Again, RTC **87** can be used for timing purposes, or counters can be used, as is well known to those skilled in the art.

Information being uploaded can include parameters and data stored in the mass storage **88** concerning the exercise sessions by the user(s) of the local system **12**. It can also include other system information used for diagnosing or improving the operation of the local system **12**. In addition, information can be downloaded to the local system **12** from the remote system computer **66** to, for example, change exercise scripts for a user, provide upgrades for the software running on the local system computer **24**, etc.

In FIG. **8**, a process **166** running on a remote system computer **66** is illustrated. The process **166** begins at **168** and, in an operation **170**, an activity type is determined. A first type of activity is a batch system connection whereby the remote system computer **66** sequentially connects with a series of local systems for the uploading or downloading of information. This process is accomplished in operation **172**. A batch system connection can be used to update the software on a number of computers **24** of local system **12**, or to upload exercise session data from a number of local systems **12** on a regular basis, e.g. daily, weekly, monthly, etc.

If operation **170** detects a single system activity type, an operation **174** connects the remote system computer **66** to a single local system **12** for uploading and/or downloading as described previously. If an activity type "Process Data" is detected by operation **170**, an operation **176** prepares data on the computer **66** for storage, processing, communication, and/or analysis. Examples of some types of analysis of the data will be discussed subsequently with referenced to FIGS. **8***a*-**8***c*. Finally, if an activity type "Server Connection" is detected, a connection is made with the server **76** to upload or download information. The server connection can be initiated by the computer **66**, or it can be initiated by the server system computer **76** depending on the circumstances. Upon the completion of any of the operations **172**, **174**, **176**, and **178**, process control is returned to operation **170**.

In FIGS. **8***a*-**8***c*, several examples of types of data analysis that can be performed on the remote system computer **66** in operation **176** of process **166** are illustrated. Of course, this analysis can be accomplished at any of the computers on the system **10** including the remote system computer **66**, server system computer **76**, peer system computer **78**, or even on the local system computer **24**. In FIG. **8***a*, a display of exercise activity is shown. This display can be on the display on a video display, such as a display **56**, or it can be printed to make a permanent record. Along the y axis are the number of

minutes of exercise, and along the x axis are the days of the week. As seen in the illustration of FIG. **8***a,* on Monday the user had twenty minutes of exercise, on Tuesday the user had sixty minutes of exercise, and on Thursday the user again had twenty minutes of exercise.

In FIG. **8***b,* another display or print out of, preferably, the remote system computer **66** is a summary of daily exercise activity. As noted, the Monday twenty minute exercise session actually consisted of a ten minute cycling session and a ten minute weight session. Also includes is a summary of the number of calories burned and other parameters associated with those activities.

In FIG. **8***c,* a plot of the user's weight as taken from scale **22** is shown illustrating the day-by-day weights of the user during part of the month of January. In this way, users are provided with good feed-back concerning the progress he/she is making in reaching their ideal weight. This information can be used by the remote or server systems to modify the exercise scripts and/or provide dietary counseling or products to the individual users of local stations **12**.

As noted, the analysis of the data is preferably accomplished at the site of the human personal trainer, i.e. the site of the remote system computer **66**. However, this analysis can also be accomplished at upstream or downstream computers. As mentioned previously, the computer **24** of the local system **12** is perfectly capable of making these types of analysis and displaying the on the display **66**. Also, a simple printer I/O port can be provided in the stationary bicycle **18** to allow a printout of the graphs and charts that were shown by way of example in FIGS. **8***a,* **8***b,* and **8***c*.

In FIG. **9**, a process **180** running on server system computer **76** is illustrated. In many ways, the process **180** running on the server system computer **76** is very similar to the process **166** running on the remote system computer **66**. The process **180** begins at **182** and, in an operation **184**, an activity type is detected. One type of activity type is the batch connection where the server sequentially (e.g. serially and/or in parallel) connects to a series of remote system computers **66** for uploading and downloading information. This process is accomplished at operation **186**. Another activity type detected by operation **184** is the single system connection accomplished in operation **188**. In operation **188**, the server connects to a single remote system for uploading or downloading. In the case of operation **186** where there is a batch connection, the server system computer **76** will almost always be the initiating computer for the connection. With the single system connection however, the initiation of the connection can come either from the server **76** or from the remote system computer **66**.

If operation **184** detects a "Process Data" activity type, the data for multiple remote system computers **66** (which includes data from multiple local system **12**) is prepared for storage, processing, communication, and/or analysis in an operation **190**. If an operation **184** determines that there is to be a peer-to-peer connection with a peer server **188**, an operation **192** makes the connection with the peer server to pass data back and forth. Of course, there are other activity types that can be performed by the process on server system computer **76**, these four being by way of example. After the completion of operations **186**, **188**, **190**, or **192**, process control is returned to operation **184** to detect another activity type.

In FIG. **10**, an Internet linked version of the present invention is illustrated. Those portions of the system that are similar to those previously described use the same reference numbers. It should be understood that while this embodiment is described in terms of the Internet, is also applicable to other forms of networking. However, a data packet network such as the Internet, or an Intranet, operating on a TCP/IP protocol is preferred.

In FIG. **10**, a local system **12***a* is provided with an Internet access apparatus **196**, and an enlarged video display such as a television **198**. The television **198** can be any standard television (currently typically an analog television) which can develop an image provided over a cable or wire **200** from the Internet access apparatus **196**. Internet access apparatus such as apparatus **196** are available from variety of vendors at the present time, and are generally referred to as a "set-top Internet boxes." Set-top Internet box **196** typically communicates with a user via Infrared (I/R) data linkages, such as I/R linkages **202** and **204**. In the present invention, these linkages are used to communicate with the local system **12***a,* as will be appreciated by those skilled in the art. Some optimization of the software in the apparatus **196** may be preferable to communicate with the local system **12***a,* although standard apparatus **196** can also be used by having the local system **12***a* emulate a remote I/R unit or remote I/R keyboard.

Local system **12***a* includes an I/R transmitter **206** which produces an I/R beam **202** that can be detected by an I/R detector **208** of the Internet access apparatus **196**. The local system **12***a* also includes an I/R receiver **210** which receives an I/R beam **204** generated by an I/R transmitter **212** of the Internet access apparatus **196**. Techniques for communicating between electronic devices with I/R beams are well-known to those skilled in the art.

If a higher-bandwidth linkage or "link" is preferred between the local system **12***a* and the Internet access apparatus **196**, a cable or the like can be provided to connect the two. Also, it will be appreciated by those skilled in the art that the Internet apparatus **196** is only one method for accessing the Internet, other methods including the use of personal computers, etc. Higher-bandwidth is likely to be desired if a video camera **214** is used to transmit video over the Internet.

The Internet access apparatus can be coupled to the Internet **216** by a number of communication linkages or "transmission media." For example, if the Internet access apparatus **196** includes a cable modem, a cable **217** can be coupled to an Internet server at a cable provider **218** to couple to the Internet **216**. Alternatively, if the Internet access apparatus is provided with a standard modem, a telephone line **220** can be coupled to a Internet server at a telephone provider **222** to couple to the Internet **216**. Finally, if a wireless modem is provided by Internet access apparatus **196** with an antenna **224**, an Internet server at a wireless provider **226** with an antenna **228** can be used to couple to the Internet **216**.

Also coupled to the Internet **216** are one or more local systems, such as local systems **12***b* and **12***c,* one or more remote systems **66'**, and/or one or more server systems **76'**. Since the local, remote, and server systems are all coupled to the Internet **216**, their hierarchy is more a logical hierarchy rather than a physical or wired hierarchy. In other words, the local systems can talk with each other and with the remote system **66**, and the remote systems can talk with each other and with the server system **76** in a "logical hierarchy."

In FIG. **11**, a computer system **24** ("local computer") of local system **12***a* is illustrated in greater detail. As previously described, the local computer **24** can comprise the motherboard of a standard personal computer that has been programmed to perform the process of the present invention. Most of these processes have already been described, and will not be repeated here. The computer **24** is operative to control the I/R transmitter **206** and the I/R detector or receiver **210** to implement communication with the Internet access apparatus **196**. As mentioned previously, these communication linkages

can be augmented or substituted by other types of communication linkages, such as a higher-bandwidth cable or twisted pair linkage to the Internet access apparatus **196**. In addition, the computer **24** can receive video data from a video camera **214** of the user. This video data can either be real time data, or a series of video "snapshots," e.g. a "frame" a video sent every few seconds. Preferably, if this video data is to be sent over the Internet, it is compressed by some form of standard compression algorithm, such as MPEG.

Also shown in FIG. **11** are a number of "active" actuators **220**, **222**, **224**, and **226**. These actuators are controlled by computer **24**. Actuator **230** is coupled to the crank **36** of the pedal **38** to provide a tactile, haptic, or "force" feedback on the pedal **38**. Likewise, actuators **232**, **234**, and **236** are provided to provide a tactile, haptic or "force" feedback on the stem **42** of seat **40**, on the stem **46** of handlebar **44**, and on the frame or enclosure **34** itself. Therefore, "real-world" forces such as hitting a rock, wind forces (which tend to exert the force on the handlebar **44**) and others can be imparted on the user of the local system **12***a*.

The actuators **230**-**236** can be motors, solenoids, and other forms of force-producing mechanisms. They can be electrically, hydraulically, or pneumatically controlled, although electrically controlled actuators are preferred. It should also be noted that the actuators can also serve as sensors that can be "read" by the computer **24**. Also, the actuators can be used to provide mechanical resistance. For example, the actuator **230** can eliminate the need for a friction-type brake **52**. Also, the actuator **234**, if of a suitable type, can be used to both sense the position of the handlebar **44** and to provide a force feedback on those handlebars.

In FIG. **12**, a "virtual exercise session" in a "virtual world" is illustrated. More particularly, an image I is developed on the screen **238** of the television **198** which simulates both the user **240** and one or more individuals **242**. These one or more other individuals can be users at other local machines, or can be the "personal trainer" at another local system or at a remote system. In this instance, the user is riding a bicycle along a road **244** and is trailing behind the other user **242** also riding a bicycle. Through the use of the actuators, the user **240** can feel the surface of the road, can get a "boost" when going downhill and feel a "drag" as he goes uphill, can feel the affects of a wind **246**, can feel the lessening of resistance to pedaling when "drafting," i.e. riding closely behind, the other user **242**, etc. With the use of the video camera **214**, an image of the other user **242** can be provided on the screen **238**, e.g. pasted onto the cycling figure's body **242**, as can be the image of the user **240** on the screen of the local system of user **242**.

Of course, there are many "virtual worlds" that one or more users of the exercise apparatus can inhabit. For example, the user can be a standard gymnasium or health club, and wander from exercise equipment to exercise equipment while interacting with other user/exercisers and personal trainers in this virtual world. In consequence, the user **240** is motivated to exercise in much the same way as if he journeyed to a gymnasium or health club, without leaving the comfort and convenience of home.

FIG. **13** illustrates a remote interactive exercise and health system **250** in accordance with a preferred embodiment of the invention. This embodiment, as was the case with the previous embodiments, may be implemented over a wide area network (WAN) such as the Internet **252**. The remote interactive exercise and health system **250** preferably includes a number of fixed local systems **254**A-**254**N and one or more mobile local systems **256**A-**256**N. The system **250** also preferably includes a remote server **258** which can include one or more physical or "virtual" servers **260**A-**260**N. The system **250** also includes one or more trainer machines **262**A-**262**N.

A fixed local system, such as fixed local system **254**A, typically includes one or more health and/or exercise devices (often referred to herein as simply "exercise devices", "exercise apparatus", etc.) such as exercise devices **264**A-**264**N. These one or more exercise devices **264**A-**264**N are associated with a fixed local server **266**. Of course, additional fixed local servers can be implemented as will be appreciated by those skilled in the art. The exercise devices **264**A-**264**N can be of a variety of types such as stationary bicycles, weight lifting machines, operation machines, treadmills, scales, etc. As a minimum, the exercise devices **264**A-**264**N should include at least one sensor which permits data to be processed and sent to the remote server system **258** via the Internet **252**. The exercise devices can also include passive devices such as scales, heart rate monitors, etc., which typically have an output dependent upon one or more sensors. It is preferable, but not essential, that the exercise device **264**A-**264**N includes some type of feedback or actuator which mechanically influence the exercise device to vary the resistance, provide tactile feedback, provide haptic feedback, etc., to a user.

Typically associated with an exercise device is a user such as user **266**A-**266**N. The users **266**A-**266**N interact with the system **250** at least through the exercise devices **264**A and **264**N. Such interaction will be referred to herein as "in-band" interaction. However, the users **266**A-**266**N can also interact with system **250** through "out-of-band" interactions **268**A-**268**B. As will be discussed in greater detail subsequently, these "out-of-band" interactions do not necessarily go through the Internet **252**. For example, a user **266**A may be interacting with the fixed local server **266**A on a separate, high speed data connection to provide real time video information to the exercise device **264**A. Alternatively, the out-of-band interaction **268**A could be a cellular phone conversation with a personal trainer.

Of course, out-of-band interaction can also be performed in-band. In a preferred embodiment of the present invention, an inexpensive controller and interface providing low-data rate "in-band" transfers for an exercise device is seen to be preferable. Such a controller will add only minimally to the cost of the exercise device (which typically needs a controller anyway), permitting manufacturers to provide the "in-band" compatibility on virtually their entire product line. This "in-band" transfer is primarily a transfer of sensor data (from the exercise device) and scripts and other data to the exercise device. Other, high bandwidth transfers, such as streaming video and audio, etc., can be accomplished with an add-on "out of band" device. For example, a head mounted display and earphones can provide an out of band experience. Nonetheless, other embodiments of the present invention utilizes a single, high-speed channel, such as an 802.11 protocol channel, to couple the exercise device to the rest of the system. Of course, this would require a much more complex controller, approaching the complexity of a personal computer, to be provided for the exercise device. If a suitably powerful controller were provided in the exercise device, then all data transfers could be "in-band."

Similarly, the mobile local systems **256**A-**256**N typically include mobile exercise devices **270**A-**270**N and mobile local servers **272**A-**272**N. In this instance, there is usually a one-to-one correspondence between a mobile exercise device **270**A and a mobile local server **272**A. However, in alternate embodiments of the present invention, two or more exercise device **270**A may be associated with a single mobile local server **272**A by, for example, wireless connection. Often, the mobile exercise devices **270**A include one or more sensors,

such as an RPM sensor, a GPS sensor, an elevation sensor, an energy expended (wattage) sensor, a pulse rate sensor, an oxygen saturation sensor, etc. The mobile exercise devices **278**A are typically not provided with actuators, although it is possible to do so. For example, a mobile bicycle can be provided with an actuator which would shift gears on the bicycle. Nonetheless, other feedback can be provided to a user of mobile exercise equipment **270**A through the "in-band" and/or "out of band" connection, such as current location, advice from the trainer, etc., via, for example, a display on a bicycle computer. Again, associated with each of the mobile exercise devices **27**A-**27**N are one or more users **274**A-**274**N. These users can interact with the system **250** by the "in-band" experience and/or by an out-of-band experience **276**A-**276**N. Again, these out-of-band experiences can be high speed data connections to the local mobile computer or true out-of-band experiences such as a cellular telephone conversation with the trainer.

The remote server **258** is in an at least part time communication with the local systems **254**A-**254**N and mobile systems **256**A-**256**N. As will be appreciated by those skilled in the art, the remote server system **258** can include one or more physical and/or virtual servers **260**A-**260**N. This permits the easy scalability of the system **250** as more users and trainers use the system. Typically, the remote server system **258** is the intermediary for communication between local systems and trainer machines, but in alternate embodiments of the present invention, local servers may communicate directly with each other or through the Internet **252** or directly to a trainer machine through the Internet **252** or other transmission media, as will be appreciated by those skilled in the art.

The trainer machines **262**A-**262**N are typically associated with individual trainers **276**A-**276**N. The trainers may interact with the system **250** through in-band communication or may communicate with, for example, users **266**A-**266**N and **274**A-**274**N through out-of-band communication **278**A-**278**N. Such out-of-band communication can be, as explained previously, cellular or telephonic communication with one or more users. Alternatively, streaming video and/or audio, video files, audio files, graphics, etc. can be provided to the user and/or the trainer through an in-band or out of band communications link. The trainer machines **262**A-**262**N are preferably personal computer systems using the Microsoft Windows or Mackintosh operating systems, for example, and provided with a display screen, keyboard, and pointing device such as a mouse. Preferably, the interface between the trainers **276**A-**276**N is a World Wide Web (WWW) type interface. For example, a web browser such as Microsoft Explorer™ or Netscape Navigator™ can be used on the trainer machines **262**A-**262**N to access a secure website on the remote server system **258**, as will be explained in greater detail subsequently.

The present system is well suited for franchise and multi-level marketing systems. Trainers can buy a franchise, or operated as an independent contractor, and sell memberships to users. A user can then either buy or lease a local system, along with the service provided by the trainer. As trainers obtain too many clients for them to personally manage, they can create sub-franchiser or sub-contractor trainers for some of the clients. The top level trainers will not only obtain compensation for each of their direct clients, but they will also obtain a smaller share of the compensation for their indirect clients through the sub-franchiser or sub-contractors. Trainers can also be sponsored, e.g. by a company for its employees.

FIG. **14** is a block diagram of an exercise device circuit which can be associated with, for example, an exercise device **264**A-**264**N or **270**A-**270**N. More particularly, an exercise device controller **280** includes an interface controller **282**, a sensor **284**, and a transmitter **286**. By "transmitter" **286**, it is meant that the appropriate drivers are provided to create a signal **288** which can be transmitted to a local server via wired, optical, wireless, or other transmission media. The sensors **284** are preferably coupled to a resistance mechanism or actuator **290**. The interface controller preferably also includes a device ID **292**, a user ID **294**, switches and keyboard **296**, and a display **298**, such as a flat panel display. The controller **280** can also optionally include an actuator **300** and a receiver **302**. The receiver **302**, like the transmitter **286**, can receive a signal **304** via a variety of transmission media including wired, wireless, optical, fiber optic, etc.

A reason for "in-band" base functionality is to make the basic controller ubiquitous to exercise equipment. By making the base functionality whereby interaction with the sensors and actuators of the exercise equipment is supported, but not necessarily high-bandwidth interactions, the controller can be made very inexpensively and put into almost any exercise device with electronic circuitry. The more expensive circuitry for high-bandwidth interactions can be provided separately with the "out of band" capabilities of the present invention.

The interface controller **282** is preferably an integrated microcontroller having microprocessor, RAM, EPROM, and various interfaces. Alternatively, the interface controller can be implemented with discrete components. The purpose of the interface controller is twofold, namely to interact with the sensor and/or actuator of an exercise device and to provide communication interfaces to a user and to other portions of the remote interactive system **250**. It is desirable that the interface controller be relatively low cost so they can be added to each piece of manufactured exercise device such that the interface become ubiquitous.

In addition to communicating with sensor **284** and actuator **300**, the interface controller **282** can provide a display on display **298** to enhance the exercise session for the user. The display can provide internally developed parameters such as RPM (in the example of a stationary bicycle), it can also display information provided by, for example, the trainer via the system **250**. The keyboard **296** is used to input various user commands into the system.

Preferably, each exercise device is provided with a device ID **292**. This identifies the particular device to the system **250**. In one preferred embodiment, the device ID is stored in an EPROM internal to the interface controller **282**. In other embodiments of the present invention, the device ID can be provided by dip switches or other coding mechanisms that can be read by the interface controller **282**.

Also preferably, each user is provided with a user ID **294**. This permits a user to use any piece of compatible equipment by entering his or her user ID, such that the system **250** knows that he or she is using that exercise device. The user ID can be provided through the keyboard **296**, or can be provided in the form of a physical key that can attach, for example, to a keychain. Magnetic keys which can store a user ID **294** are well known to those skilled in the art.

Communications between the interface controller and the rest of the system **250** through the transmitter **286** and the optional receiver **302** comprise "in-band" communication. However, there can also be out-of-band communication signals **304** between the controller **280** and, for example, a local server **266**A. These "out-of-band" signals can include, for example, high speed data communication to provide real time video (e.g. streaming video over the Internet) on the display **298**.

FIG. **15** is a block diagram of an exemplary interface controller **282** of this invention. The interface controller **282** preferably includes a system bus **306** which interconnects a number of components such as a microprocessor **308**, an EPROM **310**, RAM **312**, and a number of interfaces **314**-**322**. Optionally, the interface controller **282** can include a system ID interface **324** and a clock/counter **326**, both of which would also be coupled to bus **306**.

In certain embodiments, it is preferable that as many as the components of controller **282** as is possible are integrated into a single device. For example, the microprocessor, RAM, and EPROM, as well as a number of the I/O devices, can be integrated into a single chip. The EPROM can be EEPROM which allows the electrical reprogramming of the EPROM. Alternatively, the controller **282** can be made from discrete devices.

The EPROM **310** includes the program instructions for the controller **282**. These program instructions will be described in greater detail with reference to FIGS. **16**, **17**, **18** and **19**. Also, preferably, this system or device ID can be stored in the EPROM **310** during factory installation. The RAM **312** is used as "scratch pad" memory by the microprocessor and can serve as a buffer for the various I/O devices. The EPROM **310** and the RAM **312** comprise the primary memory for the controller **282** which may have a memory map as indicated at **328**. In this exemplary illustration, interface programming, encryption algorithms, system ID, and scripts are mapped into memory locations ranging from low (LO) memory to high (HI) memory.

The various input/out (I/O) devices include a user ID interface **314**, a sensor interface **316**, an actuator interface **318**, a keyboard interface **320**, and a display interface **322**. The primary direction of data flow is indicated by the arrow to each of these I/O devices. That is, the user ID interface provides user ID information to the system **282**, and is therefore primarily an input device. Likewise, sensor interface **316** and the keyboard interface **320** primarily provide information to the system **282** and therefore are also input devices. The actuator interface **318** and the display interface **322** "display" will provide outputs from the controller **282** and, therefore, are primarily output devices. As will be appreciated by those skilled in the art, input devices include analog-to-digital circuitry (A/D), while output devices include digital-to-analog (D/A) circuitry.

As noted above, a preferred embodiment of the invention stores the system ID in the EPROM **312**. However, it may also be desirable to have a system ID provided externally to the controller **282** via system or device ID interface **324**. This would more securely couple the device ID to the physical device, such that the controller **282** or EPROM could not be removed and placed on another exercise device. Also shown is an optional clock and counter, which in a certain embodiments is a real time clock. The clock/counter **326** is used to time various intervals, such as sleep mode, pulling schedules, etc.

FIG. **16** illustrates part of the interface programming stored in the EPROM **310** of FIG. **15**. More particularly, a process **329** is implemented on the controller **282** which begins at **330** and, in an operation **332**, the process initializes the hardware. As will be appreciated by those skilled in the art, this involves the writing to certain registers and the initialization of counters and other variables in the controller **282**. Next, in an operation **334**, it is determined whether the hardware is operating correctly. This is typically accomplished under microprocessor **308** control wherein data is written to and read from memory and various buffers, and wherein commands are sent to the various I/O devices to see if they operate correctly. If the hardware check is not okay, an error is displayed in operation **336**, preferably on the display **298** of the exercise device controller **280**. The process then ends at **338**. However, if the hardware is determined to be functional, an operation **340** reads the system ID. Next, in operation **342**, the controller **282** of an exercise device, for example **264**A, attempts to connect with a local server, such as server **266**A. If it does not successfully connect with the server, a "local mode" flag is set to indicate that there is no server connection. If the controller **282** does connect with the server, an operation **246** determines whether the server is on the Internet. If the server (such as a server **266**A or **272**A) is not connected to the Internet, an operation **348** sets the server mode flag to indicate the server is not on the Internet. If operation **346** determines that the server is on the Internet, an operation **350** sets an Internet mode flag.

Next, an operation **352** determines if there is a user ID. The invention can work in either an user identified mode, or in an unanimous mode. If there is no user ID as determined by operation **352**, an operation **354** sets an anonymous mode flag. If there is a user ID, an operation **356** reads the user ID for use by the system. Finally, the exercise session is run in an operation **358** and the process ends at **338**.

In FIG. **17**, the process "Connect with Server?" **342** of FIG. **16** is illustrated in greater detail. Process **342** begins at **360** and, in operation **362**, the start time is obtained and stored. Next, in operation **364**, it is determined whether a "ping" is received from the server. By "ping" it is meant that a message is sent from the server and addressed to the exercise device having the primary purpose of determining whether the exercise device is active or "alive." If operation **364** does not receive a ping from the server, the current time is obtained in operation **366** from, for example, the real time clock **226**, and an operation determines whether the difference between the current time and the start time is greater than a constant K. If it is, the process **342** has "timed out" and the operation is complete at **370**.

If a ping has been received from the server as determined by operation **364**, an operation **372** performs a key exchange with the server. As will be appreciated by those skilled in the art, this key exchange should be secure using one of several well known key exchange algorithms. For example, the well-known Diffie-Hellman algorithm is suitable. In one embodiment, the server can encrypt its key with a first encryption code, send it to the exercise device which then adds its own key and encrypts the entire package with its own encryption. The doubly-encrypted packet is then sent back to the server which decrypts with its encryption code, removing its own key and encrypting the encrypted packet including the key of the exercise device. The encrypted packet is then sent back to the exercise device to remove its encryption and, finally, the encrypted packet is then sent back to the server where it is decrypted by the server to remove the exercise devices key. Thus, by using multiple transmissions, the keys can be securely exchanged without broadcasting any unencrypted data.

Process **342** continues at operation **374** where it is determined whether the key exchange was successful. If it was successful, a connect flag is set to true in an operation **376** and the process **342** is completed at **370**. Otherwise, the connection flag is set to false in operation **378**, and the process is likewise completed.

In FIG. **18**, the process "run exercise session" **358** of FIG. **16** is illustrated in greater detail. The operation **358** begins at **380** and, in an operation **382**, a default script is loaded. Next, in an operation **384**, it is determined whether there is a script change command. These script change commands are pref-

erably (but not necessarily) of at least three different types. A first type of script change command is a user script change command which is implemented in an operation **386**. A second type of script change command is a server script change command which is implemented in an operation **388**. A third type of script change command is an Internet script change command which is implemented in an operation **390**.

After the implementation of one of the script change commands in operations **386**, **388**, or **390**, or in the absence of a script change command, an operation **392** executes the script on the exercise device for an interval of time. An operation **394** determines whether the process is done, and, if not, process control is returned to operation **384** to look for additional script change commands. Otherwise, the process is completed at **396**.

As used herein, a "script" is a sequence of data or commands which can be used to influence the operation of the exercise equipment. Therefore, a script can be a computer program, such as a Java Applet, or it can be a proprietary script language which is interpreted by the controller of the exercise equipment, or it can be a string of data or parameters, (e.g., duration, level, scaling, etc.), that is acted upon by the controller to influence the operation or use of the exercise device. It will therefore be appreciated that the term "script" broadly encompasses the locally executed functionality in the exercise equipment controller to influence the operation of the exercise device. Of course, as will be appreciated by those skilled in the art, portions of the "script" can be distributed, for example, to the local server or, via the Internet, to one or more systems, sensors, or machines connected to the Internet.

FIG. **19** is a flow diagram illustrating the "executed script" operation **392** of FIG. **18** in greater detail. Operation **392** begins at **398** and, in an operation **400**, the script is read according to a time interval Δt. In an operation **402**, any actuator is sent its command, and in an operation **404**, any sensor data is read. As will be appreciated by those skilled in the art, an actuator command is typically accomplished by placing data in an output buffer of the actuator interface which is then converted by D/A converters to analog signals which can control the actuator. As will also be appreciated by those skilled in the art, the reading of sensor data is typically accomplished by reading a sensor data buffer in the sensor interface which was produced by taking analog signals produced by the sensor and digitizing them with a A/D converter. The sensor and parameter data are stored in an operation **406** for later reference and processing. This data can typically be stored in buffers provided in the RAM Memory **312**.

Next, an operation **408** determines whether there is an Internet mode flag or a server mode flag. If so, the sensor data is buffered in operation **410**. An operation **412** then determines whether there is a call from the server and, if so, the sensor buffer is sent to the server in an operation **414**. If there is no Internet mode flag or server mode flag or after the completion of operations **412** and **414**, an operation **416** determines whether it is time to create an update. If so, an operation **418** updates the session parameters and the display. That is to say, the session parameters are updated in a memory store, such as RAM **312**, and a display is provided such as on display **322**. Process control then returns to operation **400**. The process **392** continues to operate until an interval of time has elapsed at which time operation **392** ceases and operation **394** on FIG. **18** takes process control.

In FIG. **20**, a fixed local server **266**A is graphically illustrated. In this embodiment, the server **266**A sits on a floor **420** between an electrical outlet **422** and a telephone outlet **424**, both of which are provided in a portion of a wall **426**. In this embodiment, the server **266**A is provided with an external power supply **428**, which also sits on the floor **420**. The supply power **428** has a cord **430** which plugs into one of the sockets of electrical outlet **422** and has another cord **432** to provide DC power to the server **266**A.

The server **266**A is preferably provided with an antenna **432**, a reset button **434**, a number of exercise device connection sockets **436**, and an Internet connection socket **438**. In a preferred embodiment of the invention, the server **266**A communicates with the exercise devices wirelessly through radio transmission emanating from antenna **432**, for example. In a wireless system, the transmitter **286** and receiver **302** of controller **280** in FIG. **14** are radio frequency transmitters and receivers. Alternatively, the server can communicate with the exercise devices by other wireless communication forms, such as infrared communication. Still further, the server can communicate with the exercise devices via a hard wire, coaxial cable, fiber optic cable, etc., connection through one of the exercise device connection sockets **436**. Likewise, while the server **266**A is shown to be coupled to the telephone outlet **424** by a telephone cable **440**, the server **266**A could also make an Internet connection through wireless devices, such as a radio modem. Further, while the outlet **424** is described as a "telephone" outlet, it will be appreciated that it also represents other hard wire and/or wireless connections to the Internet including DSL, T1 lines, fractional T1 lines, etc. That is, the telephone outlet **424** represents either an analog or digital signal connection between the outlet and the Internet which could actually be implemented by a number of different protocols.

In certain embodiments of the present invention, the human-computer interface of the local server is kept as simple as possible. For example, one embodiment of the invention the server has only a reset button as an interface. This makes the server "appliance-like" and therefore very easy to use. In other embodiments of the present invention, more complex human-computer interfaces such as a touch-screen display providing a menu of options can be provided. The wireless embodiments of the present invention also help in the appliance-like nature of the local system, as well as its scalability. For example, a new exercise device can be added to a local system by simply bringing it into proximity to the local server and hitting the reset button of the local server, and an exercise device can be removed from the local system in a similarly easy fashion. One exercise device or many exercise devices can be associated with a local server in a very scalable manner. Further, many local servers, trainer machines, and remote servers can be added to the system in a scalable fashion.

In FIG. **21**, the server **226**A includes a typical computer architecture including a bus **442** to which is a coupled a microprocessor **444**, random access memory (RAM) **446**, read only memory (ROM) **448**, as well as a number of peripherals **434**, **450** and **452**. The microprocessor **444**, RAM **446**, and ROM **448** are relatively center components and they are available from a variety of manufacturers. However, it is preferable to have the microprocessor **444** be an Intel compatible Pentium class processor so that it can run standard operating instrument systems such as the Linux operating system. Preferably, a journaling file system such as Reiser FS would be used so that the integrity of the file system would be preserved in the event of a sudden power failure. For simplicity, the RAM **446** should be static RAM (SRAM) and the ROM **448**, depending on the implementation, may be an EPROM.

The reset button **34** is coupled to the bus **442** by appropriate interface circuitry such that a reset command can be sent to the microprocessor **444**. An in-band transceiver **450** is coupled to the bus **442** to send and receive electromagnetic

radiation (radio signals) via the antenna **432**. The in-band transceiver **450** communicates with the in-band transmitter **286** and the in-band receiver **302** of **614**. The network connection **452** couples the bus to the Internet socket **438**. Depending on the type of Internet connection, the network connection **452** may take a variety of forms. For example, the network connection **452** can be a modem and the Internet connection is by regular telephone line. Alternatively, the network connection can be an Ethernet connection for connection to a digital line such as a DSL or T1 line. As is well known by those skilled in the art, the network connection is configured for the appropriate connection type.

In an expanded version of the server **226**A, there is also provided a mass storage device such as a hard disk drive **454**, a graphics accelerator **456**, and an out-of-band transceiver **458**. The addition of an hard disk drive is desirable and then it supports standard operating systems such as the Linux operating systems. Of course, other operating systems could be supported such as Windows NT, Unix, etc. However, the Linux operating system is particularly well suited for this application since it is inexpensive (free), easily configurable, and well suited for Internet connection applications. The hard disk drive can also serve as a local store for scripts, programs, commands, buffered items, graphics, video and audio informations, etc. The graphics accelerator **456** is useful for graphically driven outputs which, in a preferred embodiment, would be sent to a user by an out-of-band transceiver **458**. For example, the user could use a wireless, headmounted display with display screens in front of each of his or her eyes as well as ear phones. This type of information is of too high of a bandwidth for the preferred, low bandwidth in-band transceiver **450**, but could be handled by an out-of-band transceiver **458** transmitting on an antenna **460**. By providing this form of out-of-band communication, high quality and stereo video information could be sent to a user, as well as high fidelity and stereo audio information. This information can be viewed on a television screen, a computer monitor, a headmounted display, a display associated with the exercise device, etc., by way of the out-of-band transceiver. While the out-of-band transceiver is shown to be wireless in this embodiment, it will be appreciated by those skilled in the art that the out-of-band transceiver can also be a wired transceiver such that connection media such as electrical wire, coaxial cable, fiber optic, etc., can be used. Further, other forms of wireless transmission and reception can be used with the out-of-band transceiver **458** as well, including, but not limited to, I/R transmission and/or reception. Of course, all communication can be "in band" if the investment is made in the hardware necessary to support high-bandwidth communication. For example, the exercise equipment controller can include sufficient processing and peripheral power to utilize 802.11 wireless interconnections, which would provide enough bandwidth for completely "in-band" communications in certain embodiments of the invention.

FIG. **22** illustrates the server operating system **462** which is implemented on the server **226**A. The operating system begins at **464** with power on and, in an operation **466**, the operating system is booted. As mentioned previously, a preferred operating system is Linux, which is a public domain operating system. Preferably, the Linux is provided with Reiser FS to prevent power up and power down glitches. The booting of an operating system, including Linux with Reiser FS, is well known to those skilled in the art. Next, in an operation **468**, one or more daemons are executed. In this example, two daemons are run including Cybergym Daemon A and Cybergym Daemon B. As well known to those skilled in the art, a daemon is a process which runs substantially without interaction with the end user. An operation **470** determines whether there has been a reset based upon the pressing of a reset button **434** of FIG. **20** and, if so, the entire system is reset by turning over operational control to operation **466**. If there is no reset command, the Cybergym daemon continue to operate.

In FIG. **23**, the running of Cybergym Daemon A as part of process **468** is illustrated in greater detail. The process **468** begins at **472** and, in an operation **474**, the roster is fetched. As used herein, a "roster" is a list or the like of all exercise devices that are "known" to this server. That is, a server only communicates with a known list or "roster" of exercise devices, aka "client machines." Next, the server performs a roll call of the exercise devices on its roster in an operation **476**. If a exercise device which is on the roster does not respond despite repeated attempts, it is eventually removed from the roster. If the exercise device does respond, it is told to go to sleep, and is checked off on the roster that it met the roll call. Next, in an operation **478**, there is a broadcast greeting to new Cybergym™ machines, i.e., to new exercise devices which may have been brought within connection range to the server. If a new Cybergym machine is detected in an operation **480**, it is added to the roster and the broadcast greeting is again sent until the operation **480** does not attack any new exercise devices. At that point, the Cybergym sessions begin to execute with operation **484**.

FIG. **24** is a slow diagram illustrating the "Run Cybergym Sessions" process **484** of FIG. **23** in greater detail. Process **484** begins at **486** and, in an operation **488**, the roster is again fetched. A counter D is initialized to **1** and in operation **490** and then exercise device number D is called. If exercise device (D) responds as determined by an operation **494**, the response is processed in an operation **496** and process controller is returned to operation **492**. If there is no response from the exercise device (D), it is determined whether all of the devices in the roster has been called in operation **498**. That is, the variable D is compared to the value NDEV and, if it is less than or equal to NDEV (the number of devices in the roster), the variable D is increased by 1 in an operation **500** and operation control is return to **492**. If the entire list has been called, operation control is returned to **488** to fetch the current roster.

FIG. **25** illustrates the "process response" operation **496** of FIG. **24** in greater detail. More particularly, process **496** begins at **502** and, in an operation **504**, the communication type is determined. If it is a key exchange communication type, an operation **506** performs a secure key exchange by one of a variety of methods, as was explained previously. The process is then completed at **508**. However, if the communication type as determined by operation **504** is transmit, an operation **510** determines whether there is data available for this device. This is typically determined by looking in a lookup table associated with a buffer. If there isn't any data available, then the process is completed at **508**. Otherwise, the data is encrypted and transmitted to the device in an operation **512**. Once the data has been transmitted to the device and, preferably, the device is indicated that the data has been received and decrypted properly, the buffer is cleared for that device in an operation **514** and the operation is completed at **508**. If the communication type is "receive", an operation **516** receives encrypted data from the exercise device. Next, the encrypted data is decrypted, preprocessed, and buffered as appropriate. The process is then completed at **508**.

FIG. **25**A illustrates an exemplary data packet sent in the transmit and receive operations that were discussed with reference to FIG. **25**. In this instance, to send and receive packets are in the same format, although this is not necessarily the

case in all embodiments of this invention. In this one exemplary illustration, the data packet **520** has a set of start bits which are typically a recognizable pattern for a receiving device. Next, the user key is transmitted in portion **524** of the packet, the developer's key is provided in the portion **526** of the packet, the server ID is provided in the portion **528** of the packet, and the communication type is provided in portion **530** of the packet. In this example, following the communication type is a portion **532** which contains data. This data portion can be a fixed length or a variable length as will be appreciated by those skilled in the art. Finally, an end portion **534** of the data packet **520** signals the end of the packet.

In FIG. **26**, the "Run Cybergym Daemon B" process **468** is illustrated in greater detail. More particularly, process **468**B begins at **536**, and, in an operation **538**, there is an attempted connection to the Cybergym server. If, in operation **540**, it is determined that the connection to the server with the Internet was successful, process **468**B will run in online mode. The process **468**B will continue to run on the online mode **542** until the Cybergym server can no longer be accessed over the Internet, at which time process control will be turned over to operation **544** to run in an offline mode. This operation **544** is also evoked when the connection to the server is not successful as determined by operation **540**. The process **468**B will continue to run in the offline mode in operation **544** until an Internet connection to the server is again re-established, at which time operation control will be turned over to operation **542** to run in an online mode.

FIG. **27** is a flow diagram illustrating the "run online mode" process **542** of FIG. **26** in greater detail. The process **542** begins at **546** and, in an operation **548**, the system iterates over the exercise device buffers and collects data. That is, each of the exercise devices will have a buffer region for the storage of its data. Next, in an operation **550**, the data is encrypted. There are, of course, many suitable encryption techniques, although public key encryption is preferred in general. Public key encryption technologies are well known to those skilled in the art and are available both commercially and in the public domain (example, PGP encryption technology). Next, in an operation **552**, the data is transmitted to the Cybergym server via a socket connection. As is well known to those skilled in the art, a socket connection takes care of much of the housekeeping overhead in the transmission of data. For example, sockets typically take care of the buffering functions, etc., that implement and facilitate the transfer of data. Next, data is received from the Cybergym server via the socket. An operation **556** decrypts the data and distributes it to respective device buffers for later transmission to the devices via the process **596** as best seen in FIG. **25**. Finally, an operation **558** determines whether the Cybergym server is still online. If it is, process control is returned to operation **548**. If not, the process **542** is completed at **560**.

FIG. **28** is a flow diagram illustrating the process "Run Offline Mode" **544** of FIG. **26** in greater detail. Process **544** begins at **562** and, in an operation **564**, it is determined whether an connection to the Cybergym server has come online. If so, the process is completed at **566**, such that the process **468**B of FIG. **26** can run an online mode **542**. Otherwise, the process **544** continues to run in the offline mode and, in an operation **568**, the process iterates over the exercise devices and the buffer data. Next, in an operation **570**, it process the buffers in local mode. Finally, in an operation **572**, the process iterates over the exercise device and transmit data. Process control is then returned to operation **564**.

As will be apparent to those skilled in the art, as it is used herein "iterate" means that the system is going through the roster device by device or buffer by buffer in an iterative fashion. That is, from a starting point, it first processes the device or buffer associated with that starting point, and then the point is iterated (typically by 1) to process the next device or buffer in the roster or other list. When the end of the roster or list is reached, it may be started again from the beginning in a circular fashion.

FIG. **29** is an illustration of a mobile local system. More particularly, the mobile local system has a mobile exercise device controller **270**A and a mobile local server **272**A, which may be coupled together in an either wired or not wired fashion. Still alternatively, the devices **270**A and **272**A can be coupled together by the frame of the bicycle **274** or otherwise. It is quite common for bicycles to be provided with bicycle "computers" which provide such indication as speed, RPM, altitude, etc. The mobile exercise controller **270**A would take over this functionality as well as providing the functionality of the exercise device controller **280**. The mobile local server **272**A would have essentially the same functionality as the fixed server illustrated with reference to FIG. **21**, except that it preferably is a more "stripped-down" version, not including the options of the hard disk, graphics accelerator, and out-of-band transceiver. Also, lower power consumption devices would typically be used, and the connection to the Internet is by radio modem from an included antenna.

The mobile system illustrated in FIG. **29** can be in two-way communication via, for example, a cellular telephone system **576**. Alternatively, radio modem services such as formerly provided by Ricochet, would be another communication methodology. While the server **272**A could conceivably service a number of control units **270**A, it is likely to be dedicated solely to that control unit. This is because bicyclists may not always be in sufficient proximity for the units **270**A to communicate with a single server **272**A and, in fact, bicycles that are in close proximity may not want to share the same server **272**A. Exceptions include such situations as group races or competitions, such as the Tour de France. In such an instance, a server **272**A could be in a pace car, which would service a number of controllers associated with individual bicycles.

The server **272**A is also preferably included with a variety of sensor inputs, including GPS from multiple satellites **578**, altimeter readings based on, for example, atmospheric pressure or, alternatively calculated from GPS information, inclinometers, etc. In this fashion, a mobile exercise device user can interact with a remote server, a trainer, or compete against other mobile and/or fixed exercise devices. For example, a user can be riding the bicycle while data such as distance, speed, RPM, elevation gain, etc., are transmitted to the remote server and provided to the trainer. The trainer can then download scripts or programs to the unit **270**A indicating that a user should pick up the pace, shift to a lower gear, etc. Furthermore, out-of-band communications can also occur with the trainer, for example, by cellular telephone connection. The mobile exercisers can also compete and interact with fixed exercisers, again with some scaling and/or handicapping.

FIG. **30** is an illustration of yet another form of mobile local system **256**B. More particularly, sensors and transmitters can be provided in the shoes **580** of a runner **582** which communicate with a mobile local server **272**B attached to the belt **584** of the runner **582**. For reasons similar to those discussed before, it is preferable that there be a one-to-one correspondence between the mobile units **270**B and the mobile local server **272**B. As was the case discussed with reference to FIG. **29**, the mobile local server **272**B can communicate with the Internet via a variety of channels, including radio modem channels, cellular phone channels, etc. The local mobile server **272**B also preferably has multiple sensor-

ing modes, including GPS. Similar sensors can be provided for other sports and activities such as weight lifting, swimming, etc.

As indicated above, the mobile interactive local systems allow a user (athlete) to at least upload data via the Internet and, preferably, download information. While the "in-band" bandwidth may be somewhat limited in certain embodiments, it can be augmented without a band communications as well. In addition to allowing the recording of exercise parameters on the Cybergym server and interacting with a Cybergym trainer, the mobile exercise devices permit competitions, even against different classes of exercise devices. For example, with a suitable handicap, a runner can race against a cyclist who may be competing with someone on a stationary rowing machine. This also permits amateurs (presumably on fixed exercise devices) to compete with professionals on mobile exercise devices. Furthermore, "virtual worlds" can be created with which one or more users can interact. In one scenario, each user can be represented by a spaceship which can "fly" through space, have dogfights, etc. based upon the use of the exercise devices and optional in-band or out of band controllers.

FIG. **31** illustrates a possible screen that can be displayed on the personal computer system **262**A of a trainer **276**A. As described previously, in a preferred embodiment of the present invention, the computational functionality with respect to the trainer machine **264**A is provided by the Cybergym server **258**. Therefore, the trainer **276**A needs only to install a network browser on his trainer machine **262**A to enjoy full functionality of the system **250**. In this instance, the trainer **276**A point to his browser to a URL **588**, namely https://www.trainer.Cybergym.net. This brought up the display allowing the trainer to choose from a number of options. For example, the trainer can choose option: 1) coach online clients; 2) coach offline clients; 3) manage his or her coaching business; and, 4) communicate with Cybergym management. As is well known to those skilled in the art, the trainer **276**A can select one of these options with a pointer **590** controlled by a pointing device such as a mouse or trackball. The trainer **276**A then "clicks" on the pointer **590** by depressing the button on the mouse or trackball to select the appropriate next screen. It should be noted that these communications are all secured and encrypted, and are run over an https://connection.

FIG. **32** illustrates a screen **592** which can be accessed by selecting the "Coach Online Clients" option from the list on screen **586**. This is again a secure connection and it indicates all of the users in the group belonging to trainer **276**A that are currently online. If the user has a exercise device provided with a video camera, the image of the user is displayed on the screen as shown. If the user is not working with an exercise device equipped with a video camera, and "A" is provided in place of his or her image to indicate that they are riding anonymously, at least in the visual sense. Preferably, the trainer **276**A also has a trainer machine **262**A that is provided with a video camera which would allow his or her image to be displayed at the exercise device, as long as it was provided with sufficient out-of-band devices. Of course, as the capability of in-band transmission increases, this information may also be transmitted to the user via an in-band connection, as described above.

FIG. **33** illustrates a screen **594** which was accessed by selecting the user Jane Doe at **593**. This provides a full screen of information specifically about the user Jane Doe. The screen **594** can include a video portion **596**, basic information **598** about the user, information **600** concerning her exercise program, a variety of graphs and charts **602**, **604**, and **606** illustrating various parameters of her exercise history, and a comments field **610**. The screen **594** also preferably displays a display of the current script **612** running on the device while allowing the trainer to modify it and submit it back to the device by means of a on-screen button **614**. Similarly, the screen **594** also preferably includes a program window **616** which allows the trainer to view and modify the overall program for the user Jane Doe and to submit it by the on-screen button **618** to the user exercise device. An on-screen button **620** permits the trainer's camera to be toggled on and off and an on-screen button **622** permits a microphone to be switched on and off so that the trainer can either talk or not be heard by the user.

In FIG. **34**, a Cybergym™ server **260**A is described in greater detail. As will be appreciated by those skilled in the art, a server **260**A includes a hardware component and a software component. The hardware component (not show) is typically a personal computer, workstation, network server, etc. Sometimes it is implemented as a "virtual machine" wherein a number of logical machines are implemented on a single hardware machine. The software component **624** provides the functionality of the Cybergym system.

Software component **624** is based upon a database **626** which is used to store and retrieve information, programs (scripts), graphics, video, telemetry, and other data used in performance of the Cybergym system. This database is preferably provided as a relational database, such as is provided by Oracle Corporation of Redwood Shores, Calif.

Communicating with the database **626** are daemons **628** and servlets **630**. The purpose of the daemons is to service the local servers, such as servers **254**A, **254**N and **256**A, at least partially through the Internet, or other Wide Area Network (WAN). The purpose of the servlets is to is to service the trainer machines, such as trainer machines **262**A and **262**N, as well as any personal computer or "workstation" **632** used by a user. As is well known to those skilled in the art, servlets are often used to provide web-based interfaces to database driven web sites.

FIG. **35** illustrates the daemon **628** of FIG. **34** in greater detail. Daemon **628** begins at **634** and, in an operation **636**, establishes a connection to the database **626**. Next, in an operation **640**, it determines whether there is a new connection with a local server. If so, an operation **642** opens a socket to communicate with a local server (such as local server **266**A or **272**A), and starts a new "thread." As is well known to those skilled in the art, a "thread" is a new process which operates asynchronously from its parent process (i.e. daemon **628**). Next, in an operation **644**, the socket connection made by operation **642** is processed. Process control then returns to operation **640**.

If operation **640** does not detect a new connection, then the daemon is put to "sleep" for a period of time k seconds, e.g. k=1-5 seconds. After the period of time has elapsed, an operation **650** determines if there is a system shutdown. If so, the operation of the daemon **628** ends at **652**. Otherwise, process control is again returned to operation **640**.

FIG. **36** illustrates the process "Process Socket Connection" **644** of FIG. **35** in greater detail. Process **644** begins at **654** and, in an operation **656**, the user ID(s) and system ID(s) are obtained from the socket that was created by operation **642**. Next, in an operation **658**, the data base is accessed to obtain any scripts or other data or programs that are to be sent to the local servers. Operation **660** determines if there are any scripts available and, if so, they are transmitted to the local server via the socket in an operation **662**. If there is telemetry or other data communication available from the socket as determined by an operation **664**, the telemetry and/or other data communication is read from the socket in an operation

666 and is written to the database in an operation 668. An operation 670 then determines whether the connection has been lost, at which time the process is terminated at 672. Otherwise, process control is returned to operation 658 to continue the processing.

FIG. 37 is a flow diagram illustrating the servlet process 630 in greater detail. The servlet 630 begins at 674 and, in an operation 676 it is determined if there is a "connection" from the web. By "connection" it is meant that a connection or "request" has been sent from an Internet enabled machine to the server 260A. Upon the receipt of the request from, for example, a trainer at a trainer machine 262A or a user at a personal computer 632, the operation will recognize the desired connection and, in an operation 678, will start a new thread next, in an operation 680 the connection is processed, and the servlet will have completed its process at 682. If a connection from the web is not recognized by operation 676, an operation will determine if there has been a system shutdown. If so, the servlet is again completed at 682. Otherwise, process control is returned to operation 676 to again look for a connection from the web.

FIG. 38 illustrates the process "Process Connection" 680 of FIG. 37 in greater detail. The process 580 begins at 686 and, in an operation 688, parameters are received from the request that came with the connection. Next, the parameters are processed in an operation 690. For example, if the trainer or user specified a request for information concerning a specific exercise session, it might be necessary to transform the name of the person received in the request into a user ID. Next, in an operation 692, the data, program, graphic, video, etc. ("information") required to fulfill the request is read from the database 692. Next, the information is processed in an operation 694. An operation 696 determines whether the database should be updated, based on the request type. For example, some requests merely interrogate the database for information, while others require the storage of information in the database. If the database is to be updated, an operation 698 writes to the database and the process 680 ends at 700. Otherwise, an operation 702 transmits the reply back to the requestor, and the process again ends at 700.

It will therefore be appreciated that in a preferred embodiment of the present invention, a distributed wide area network (WAN) such as the Internet is used to couple local servers, remote servers, and workstations together. Users at local systems can interact visually and even in a tactile manner with other users over the Internet. For example, a first user at a first local station can take a "virtual ride" with another user at a second local station through the Internet connection. Likewise, a remote "personal trainer" can interact with a user at a local station via the Internet communication linkage. The present invention therefore allow group exercise experiences, even when a user is physically alone.

While this invention has been described in terms of several preferred embodiments, it is contemplated that alternatives, modifications, permutations and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. It is therefore intended that the following appended claims be interpreted as including all such alternatives, modifications, permutations and equivalents as fall within the true spirit and scope of the present invention.

What is claimed is:

1. An exercise system comprising:

a mobile unit including at least one mobile exercise monitoring sensor coupled to mobile exercise equipment for monitoring a mobile exercise activity performed by a user on said mobile exercise equipment, said mobile unit at least temporarily storing, in memory, mobile exercise activity data sensed by said at least one mobile exercise monitoring sensor, said mobile unit communicating said mobile exercise activity data to a mobile system for communication over a wide area network;

a fixed local unit including at least one local exercise monitoring sensor coupled to fixed local exercise equipment for monitoring a local exercise activity performed by a user on said fixed local exercise equipment, said fixed local unit at least temporarily storing, in memory, local exercise activity data sensed by said at least one local exercise monitoring sensor, said fixed local unit communicating said local exercise activity data to a local server for communication over said wide area network; and

a remote server coupled to said wide area network for receiving via said wide area network said mobile exercise activity data and said local exercise activity data, said remote server selectively storing said mobile and local exercise activity data in a computer-readable media, wherein said remote server processes said mobile and local exercise activity data by comparing said mobile and local exercise activity data and scaling said mobile and local exercise activity data based on differences between said mobile exercise equipment and said fixed local exercise equipment.

2. An exercise system as recited in claim 1 wherein said mobile exercise equipment comprises at least one of a bicycle and an athletic shoe.

3. An exercise system as recited in claim 1, wherein said mobile unit is in wireless communication with said mobile system.

4. An exercise system as recited in claim 1 wherein said monitoring sensor includes a transducer developing an analog signal and an analog-to-digital converter which converts said analog signal to a digital signal.

5. An exercise system as recited in claim 1 wherein said monitoring sensor includes a global positioning system (GPS) unit.

6. An exercise system as recited in claim 1, wherein said fixed local exercise equipment comprises at least one of a stationary bicycle, a rowing machine, a step machine, and a treadmill.

7. An exercise system as recited in claim 1, wherein said fixed local unit is in wireless communication with said local server.

8. An exercise system as recited in claim 1, wherein said mobile system is associated with a pacer vehicle separate from said mobile unit.

9. An exercise system as recited in claim 1, wherein mobile exercise activity performed by a user on said mobile exercise equipment results in physical travel of the user over a substantial distance.

10. An exercise system as recited in claim 1, wherein the user of said fixed local exercise equipment remains in substantially the same location while performing local exercise activity on said fixed local exercise equipment.

11. An exercise system as recited in claim 1, wherein said remote server processes said mobile and local exercise activity data by comparing an actual distance traveled by the user of said mobile exercise equipment to a virtual distance traveled by the user of said fixed local exercise equipment.

12. An exercise system as recited in claim 1, wherein,

said mobile unit comprising a bicycle and said at least one mobile exercise monitoring sensor coupled to said bicycle, wherein riding said bicycle results in physical travel of the user over a substantial distance;

said fixed local unit comprising a treadmill and said at least one local exercise monitoring sensor coupled to said treadmill; and

said remote server is associated with a website.

13. An exercise system as recited in claim **12**, wherein said remote server processes said mobile and local exercise activity data by scaling said mobile exercise activity data or said local exercise activity data to account for the differences between said bicycle and said treadmill.

14. An exercise system comprising:

a mobile unit including mobile exercise equipment and a sensor associated with said mobile exercise equipment for monitoring a mobile exercise activity performed by a user on said mobile exercise equipment and developing mobile exercise activity data, said mobile unit communicating said mobile exercise activity data to a mobile system, said mobile system comprising a mobile server for communicating said mobile exercise activity data over a wide area network;

a fixed local unit including fixed local exercise equipment and a sensor associated with said fixed local exercise equipment for monitoring a local exercise activity performed by a user on said fixed local exercise equipment and developing local exercise activity data, said fixed local unit communicating said local exercise activity data over said wide area network; and

a remote server coupled to said wide area network for receiving said mobile exercise activity data and said local exercise activity data, wherein said remote server processes and handicaps said mobile and local exercise activity data by scaling said mobile exercise activity data or said local exercise activity data to account for i) said mobile and fixed local exercise equipment being different types of exercise equipment, ii) differences in operating parameters of said mobile and fixed local exercise equipment, or iii) differences in environmental conditions at said mobile unit and said fixed local unit.

15. An exercise system as recited in claim **14**, wherein said remote server communicates results of the processing and handicapping of said mobile and local exercise activity data to the users of said mobile and fixed local exercise equipment.

16. An exercise system as recited in claim **15**, wherein said results comprise an indication of a winner of a race between the users of said mobile and fixed local exercise equipment.

17. An exercise system as recited in claim **14**, wherein said mobile server is caffied or worn by the user of said mobile exercise equipment.

18. An exercise system comprising:

a mobile unit comprising i) mobile exercise equipment upon which a user can perform a mobile exercise activity, ii) a mobile sensor coupled to said mobile exercise equipment for monitoring said mobile exercise activity and developing mobile exercise activity data representative of said mobile exercise activity, and iii) a mobile server caffied or worn by the user of said mobile exercise equipment, said mobile server being in wireless communication with said mobile sensor, said mobile sensor communicating said mobile exercise activity data to said mobile server, said mobile server communicating said mobile exercise activity data over a wide area network;

a fixed local unit comprising i) fixed local exercise equipment upon which a user can perform a local exercise activity, ii) a local sensor coupled to said fixed local exercise equipment for monitoring said local exercise activity and developing local exercise activity data representative of said local exercise activity, and iii) a local server associated with said mobile exercise equipment, said mobile server being in communication with said local sensor, said local sensor communicating said local exercise activity data to said local server, said local server communicating said local exercise activity data over said wide area network; and

a remote server coupled to said wide area network for receiving said mobile and local exercise activity data, wherein said remote server processes and handicaps said mobile and local exercise activity data by scaling said mobile exercise activity data or said local exercise activity data to account for i) said mobile and fixed local exercise equipment being different types of exercise equipment, ii) differences in operating parameters of said mobile and fixed local exercise equipment, or iii) differences in environmental conditions at said mobile unit and said fixed local unit, said remote server communicating results of the processing and handicapping of said mobile and local exercise activity data to the users of said mobile and fixed local exercise equipment, wherein the results include an indication of a winner of a race between the users of said mobile and fixed local exercise equipment.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,549,947 B2
APPLICATION NO. : 11/150914
DATED : June 23, 2009
INVENTOR(S) : Hickman et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5
Line 64, change "use" to --user--

Column 17
Line 12, change "27A-27N" to --270A-270N--

Column 19
Line 30, change "input/out'' to --input/output--

Column 23
Line 16, change "an" to --a--

Column 25
Line 56, change "an" to --a--

Signed and Sealed this

Sixteenth Day of February, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office